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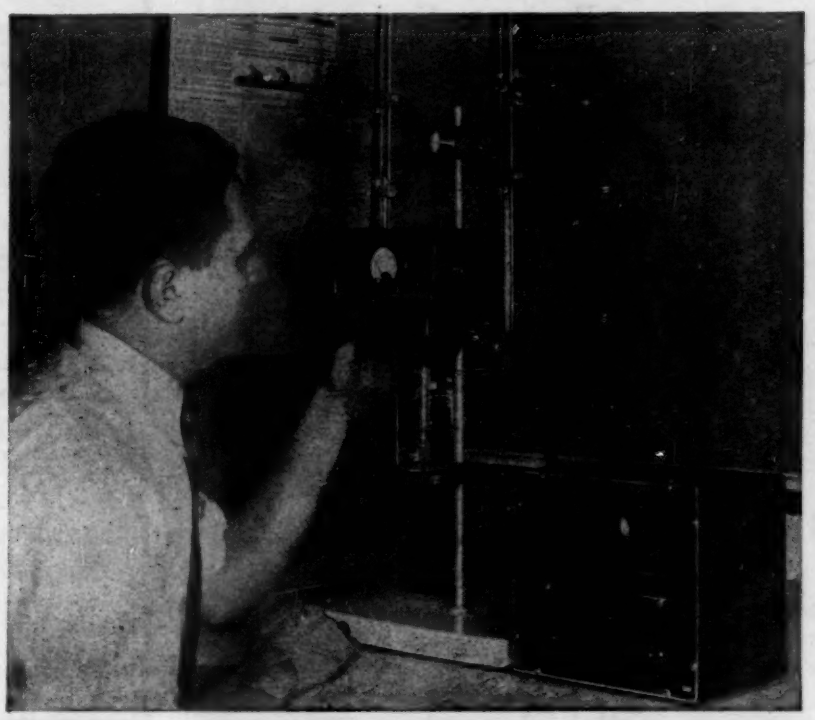

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SCIENCE

VOL. 95 FRIDAY, MARCH 27, 1942 No. 2465

Higher Levels of Integration: DR. R. W. GERARD 309

How Plant Breeding Programs Complicate Plant Disease Problems: DR. NEIL E. STEVENS 313

Obituary:
Lawrence Joseph Henderson: DR. RONALD M. FERRY. *Recent Deaths* 316

Scientific Events:
The Coming Harvest in the United Kingdom; Report of the Treasurer of Yale University; Junior Engineering Students and the War Industries; The Finney-Howell Research Foundation; The Permanent Science Fund of the American Academy of Arts and Sciences; The Nutrition Foundation 319

Scientific Notes and News 321

Discussion:
On the Stridulations of Insects: HOWARD D. MATTHEWS. *The Relative Effects of Anoxia:* PROFESSOR J. M. JOHLIN. *Calendar Reform and 364-day Years:* DR. ALFRED GUNDERSEN. *A Study of Faunal Distribution:* PROFESSOR G. D. HALE CARPENTER 324

Science Twenty-five Years Ago:
The Relations Between Engineering and Science: HENRY M. HOWE. *Our Psychological Association and Research:* J. MCKEEN CATTELL. *Notes* 326

Scientific Books:
Cytology, Genetics and Evolution: PROFESSOR C. E. MCCLUNG. *Occupational Diseases:* DR. ALICE HAMILTON 327

Reports:
Grants Made by the Banting Research Foundation: DR. V. E. HENDERSON 329

Special Articles:
The Effect of Colored Ions on the Photo-inactivation of Invertase: DR. THOMAS F. ANDERSON and HENRY LARDY. *The Occurrence of Fits in Pyridoxine Deficient Rats:* DR. SAMUEL LEPKOVSKY, MYRTISE E. KRAUSE and MILDRED K. DIMICK. *Effect of l-Ascorbic Acid on the Isolated Frog Heart:* DRS. R. P. LINSTEAD and OTTO KRAYER 330

Scientific Apparatus and Laboratory Methods:
The Sterile Culture of Paramecium Multimicronucleata: DR. W. H. JOHNSON and E. G. S. BAKER. *The Significance of Fibrinolysis in the Mechanism of Coagulation of Blood:* DR. HENRY J. TAGNON 333

Science News 8

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HIGHER LEVELS OF INTEGRATION[1]

By Dr. R. W. GERARD

PROFESSOR OF PHYSIOLOGY, UNIVERSITY OF CHICAGO

OF the several integrating mechanisms which convert a cell population into a multicellular individual, that of transmission is mainly responsible for the differences between "higher" and "lower" organisms. As it has improved, so has adaptive amplification, the ability of an individual to respond to environmental events, including those related to other individuals. This paper will be concerned, consequently, with the evolution of transmissive mechanisms and with the unit-whole relations which they serve—between cells in the organism and between organisms in the social group.

[1] From an address at the University of Chicago Fiftieth Anniversary Celebration. The complete paper will appear in Biological Symposia, Vol. 8.

TRANSMISSION

Protoplasm, subjected to an adequate stimulus, enters a new and often specific state; it gives its characteristic response—a muscle twitches, a gland secretes. But the response is not restricted to the stimulated region: the urchin egg starts to lift its membrane where the sperm enters, but this continues to rise around the whole egg; the end portion of a muscle fiber, far from the point of nerve entry, participates in the general shortening. Something, some form of excitation, must be propagated or communicated from the originally excited region to neighboring ones; and this is the essence of transmission. This universal capacity of protoplasm to hand on excita-

tion is developed into an exquisite talent by the nerve cells, once they appear. Along their fantastically extended straight processes the nerve impulses, propagated excitation waves, rush to various destinations.

Evolution exhibits striking directional changes in the transmissive capacities of organisms. In speed, for example. The egg membrane rise crawls at the rate of a centimeter an hour; in the adult sponge a message goes that distance in a minute. With the appearance and improvement of a nervous system rates jump precipitously—to 10 cm a second in the net-like nervous system of the jellyfish bell, to a meter a second in the longitudinally directed nervous system of the worm, and to ten and a hundred times this speed in the nerve fibers of arthropods and finally of vertebrates. Or in distance. Excitation in the sponge dies out in a centimeter or two, but neural transmission is unlimited since the impulse retains full intensity as it travels. Or in pattern. Transmission is diffuse in the egg or sponge and essentially so along the interlacing nerve cells of the jellyfish. But in the worm, with nerve cells grouped at each segment, most stimuli elicit local reflexes, and behavior is largely segmental and highly stereotyped in terms of fixed nerve connections.

Vertebrates have elaborated these segmental channels but have added control by functional state, have superposed dynamic patterns on structural ones, and have greatly enhanced the modifiable and integrative aspects of behavior. Such attributes are particularly related to the suprasegmental brain, mainly the cerebral cortex, which originates in the reptiles, flowers in the mammals and culminates in man. The cerebrum dominates the brain stem mechanisms and introduces latitude in the type and timing of total response to a fixed stimulus. It permits that gradual shift in behavior with accumulated experience, which we call learning; and when sufficiently developed, as in man, it permits abstraction and the direction of action by language and other symbols.

The nervous system adjusts an animal to its environment; the environment, reciprocally, has fostered the development of the nervous system. The front end of a moving animal receives most stimuli. There sense organs become more sensitive—to feebler and more variegated and more distant changes—and from them an ever increasing rain of impulses pours into the primitive brain. There the raw sensory data must be coordinated if a unified behavior is to ensue, and there the continued lash of excitation somehow led to the great overgrowth of the cerebrum—from the original nervous center for smell, the first "distance" sense. The environment dominates the receptors and these the brain as this dominates the spinal cord or the nervous system the entire body. A higher organism, then, has advanced beyond a lower one in its ability to respond to more kinds and gradations of environmental change with behavior which is more rapid, complex, variable, integrated and especially adaptive.

The anatomy and physiology of the nervous system have psychological correlates. The automatic segmental portion is dedicated to self-preservation, and the awareness attending its functioning is unthought affect or feeling. This is evoked almost routinely by particular stimuli and serves individual concerns. It is the selfish part of the psyche. Cerebral awareness is more abstract and represents the reasoning, valuing, aspiring part of consciousness. It is the social part of the psyche which transcends the immediate and selfish and makes group living possible. Injury to or removal of the cerebrum impairs or abolishes the unselfish care which the mammalian mother gives, often at her own sacrifice, to her young and so to her race; but it merely exaggerates the aggressive competitive behavior, seen so clearly in the battles between males for possession of a herd.

It is important that suprasegmental function is gaining still over segmental function, if not by anatomical growth at least by physiological exercise—via education and the swelling base of knowledge. And with this must come a relative increase of altruism over selfishness with continued biological or social evolution. Indeed this is seen at all levels of the living world, for with evolutionary advance there is progressive emphasis on cooperation of unlike units relative to competition between like ones. Both elements are always present, in a cell's protoplasm as in a human nature; but a step towards differentiation of units and their reintegration into a cooperating whole has always been retained—presumably because it has survival value. This is equally clear for the special organelles of cells, the special cells and tissues of many-celled individuals, and the special individuals of colonies or social groups.

Part and Whole

A unit system composed of lesser units in some degree of interrelation, in contrast to a mere unrelated assemblage, is an organism in the broad sense. To avoid confusion with animate organisms, this has been called an org, and the subclass of living systems, animorgs. Orgs differ in degree of integration and level of organization. As integration increases the control of the units by the org becomes relatively greater—as in passing from molecules in a gas, to a liquid, to a surface film; and the units commonly show greater differentiation—surface molecules become different (often permanently so) from others. An org at one level may, in turn, be a unit in an org of higher level—molecules in cells, cells in multicellular organisms. The degree of integration is determined by the

lations between penultimate units and whole—a onge is a poorly integrated org at the multicellular vel, although its cells are highly integrated orgs at e cellular level.

Animorgs are distinguished by several criteria: they ossess a structure based on carbon and water, colloids and membranes; they show a continuous ange with time, development of the individual or e type; they manifest the same activities of namic equilibrium (roughly metabolism), specific nthesis (roughly growth), and adaptive amplifica- n (roughly behavior); and they are integrated by e same gradient, mechanical, transportative and nsmissive coordinating mechanisms.

The panorama of evolution shows a strong tendency r animorgs, indeed for orgs in general, to evolve wards increasing integration at any one level and superpose additional levels of complexity. Thus, the subcellular level molecular orgs increase in tegration until autocatalytic and virus molecules ppear. The cellular level is then added, with mole- les (including autocatalytic ones) as units, and at his new level integration again advances from that the simplest micrococci to that of the most elaborate agellates. Another level, of multicellularity, is then dded and metazoans increase in integration and com- lexity from the sponge through man. There is no bvious reason why the multicellular individual should main the highest level of evolutionary invention, nd in fact it does not.

Multicellular organisms are as clearly built into igher level animorgs, which may be called epiorgan- ms, as are cell animorgs built into multicellular ones. The colonial coelenterates become that striking indi- idual epiorganism, a Portuguese man-of-war, in the xtreme case; the social insects evolve from the most rude and temporary groups into the highly charac- teristic epiorganism of the single beehive or anthill or rmite nest. The physiological structure of a par- ticular termite colony and the physical characteristics of its nest are as unique for each species as are the attributes of the individual insects; yet the nest is the collective achievement of the group and quite beyond the capacities or level of the individual. In the same way, the mammalian family and herd and ultimately the larger human social groups constitute various epi- organisms. These are poorly integrated at the epior- ganismic level and such units as a single nomad tribe, the British Empire, the human race and the entire ecological community may be chosen as overlapping examples of human epiorganisms.

Such groups of organisms form a true unit, albeit often a poorly integrated one, and it is an animorg by all the defining criteria—composition, develop- ment, activities and integrating mechanisms. Con- sider, for example, just the question of transmission, since the whole material has been presented elsewhere.

Transmission is called communication in the society and is mediated largely through the seen or heard symbol which is the analogue of the propagated protoplasmic or nerve impulse. Our symbols, our language, correspond still to the graded transmission of undifferentiated protoplasm, rather than to the sharply all-or-none messages carried by nerves; but these are also evolving and their precision is being enhanced with the aid of semantic and semiotic disciplines. Also in the evolving epiorganism, as in the organism, the speed and distance of effective transmission steadily increases, and the units particularly responsible for communication become centralized—we need glance no further than the great newspaper and radio chains. Finally, the driving evolutionary factor in the case of the epiorganism, as of the organism, is the stimulating action upon it of its environment. External stimuli lead to high specialization of receptors which receive them, and the receptors in turn become the dominant elements in the organismic gradient and so lead its development. The social receptors which continually expand their sensitivity to the outer world are the scientists, and these units now point the direction of social evolution. All agree that this is the "age of science," whether they like it or not.

Of the many objections to the organismic view of society, two have been especially urged: (1) coherence of the social group depends largely in inanimate materials, and (2) the component units are spatially separate and independently mobile individuals.

As regards the first, it may suffice to point out that in the organism, likewise, much of the body material and structure is clearly dead, although laid down under the influence of living cells. It is even true that special types of non-living material become increasingly important as multicellularity appears and develops. Thus the wood walls and tubes of the higher plants are completely dead yet highly serviceable to the organism; as are the calcareous or chitinous skeletal structures of many animals. Our own outer skin and nails and hair, most of our bone and cartilage, the great masses of connective tissue fibers which support and give cohesion to our tissue cells and our body fluids, including the great fluid fractions of lymph and blood, are all completely dead. They have been built or accumulated by the action of living cells, but are not themselves alive and in many cases never were. Wood, bone, chitin, sclero-proteins have been overwhelmingly invented or applied by the multicellular organisms. In the same way, not solitary but social man has introduced as new structural materials in the body of his epiorganism such substances as cement, rubber, plastics and metals.

As for the second point, the separation and mobility

of the units, similar parallels can be seen in the animal body, as in the wandering digestive cells of invertebrates. But an especially beautiful case is at hand in the slime molds studied by Raper. Through the entire period of vegetative life, the many single amoeba-like cells pursue their independent ways, seemingly an uncoordinated aggregate of separate individuals. Yet when food fails the myxamoebae stream together to form a characteristic ensheathed worm-shaped mass. This has a dominant head end which leads the rather considerable migration of the whole and which finally becomes a particular region of a sporebearing fruiting body. This latter is a morphologically and physiologically distinctive multicellular organism. In the same way, individual men may seem to pursue their "independent" courses (yet far more interdependent than are the vegetative myxamoebae) under "normal conditions"; yet they also promptly manifest their character as units in a greater whole when conditions demand. In the supreme emergency of warfare, the overt integration into a greater whole, the army, is almost as complete as in the ordinary multicellular organism, with the units often in close physical contact and with independent mobility largely abrogated.

Man and Society

Man then is an org, an individual organism, and he is part of an org, a unit in an epiorganism. Many of the problems and conflicts in human nature and in social relations seem to stem from this fundamental duality. As societies develop there is an indubitable trend towards greater cohesion—in the so-called democracies only less than in the avowed totalitarian states. (Reasons for not equating this trend with Naziism or any other existing dictatorship are developed elsewhere.)

Societies evolve into more integrated orgs and the parts, down to individual man, become more subordinated to the larger group. As the royal government overcame and absorbed those of the petty nobles, so our federal government is inevitably growing relative to state governments; and it is not a question of if, but only of when, an effective international unit will supplement, and eventually largely supplant, our present national ones. Isolationism is a biological anachronism.

The individual is also, of course, changing under the influence of the epiorganism in which he develops; and he both gains and loses freedoms. Social man has lost the freedom to run naked in summer, but has acquired the freedom of turning on the furnace in winter; he has lost the freedom to kill his fellows, but has acquired the enormous freedom conferred by a language with which he can discuss disagreements. There is no question that we prefer the new freedoms gained to the old ones surrendered. The important point is that healthy evolution brings about these changes by subordination, not by suppression. The individuals are imperceptibly conditioned to their social mileu, the internal environment of the epiorganism, and overwhelmingly they behave as they do with no feeling of coercion but rather with one of free and voluntary action.

Perhaps the most significant of these gradual changes in individual men, considered collectively, is the progressive growth of altruism. Altruism at the social level is a manifestation of the same cooperative actions which are present always between the units of an org and which are enhanced by evolution at each biological level. As single cells with differentiated cooperating protoplasmic structures have appeared and prospered in the course of evolution; as multicellular organisms have steadily moved towards more specialized and interdependent parts and organ systems; as the mother cares for and sacrifices in behalf of the young in the family org, and the individual member of many a subhuman group helps and sacrifices for his fellows under an impressive variety of conditions; so in humans individual loyalty towards and service or sacrifice in behalf of the group—trade or professional organization, religious body, and particularly the whole state—is marked and is increasing.

There are, however, serious transitional problems which may well become worse before being resolved. They arise peculiarly, I think, from the existence of very highly integrated units in a still very poorly integrated org. The amount of physical power wielded by the society, and the differentiation of its unit members into highly developed specialists of all kinds, have increased faster than have those coordinating mechanisms which must effectively reintegrate these units into the whole. (This one might regard as a consequence of the earlier and more lusty growth of the physical sciences as compared with their social counterparts; and it is a healthy sign that to-day so much constructive thought and support are being given to the development of the latter.)

Society, for example, is in bitter need of better mechanisms for selecting its leaders, the individuals who will play the dominant role in the social gradient, as the brain and receptor cells exercise physiological leadership in our own bodies. When proper leaders—men qualified by talent and training for the duties demanded in the position of social leadership—can be selected by devices which are more dependable and objective than are the accidents of family, rhetoric, ambition and other circumstances which to-day frequently toss undesirable individuals to the apex of the power pyramid, I believe that the most serious of the world's afflictions will have been conquered. The social mechanisms of integration are continuously

evolving by invention and the pressure of necessity. They will be tested and will endure or be superseded on the same criteria of fitness for survival that have led, through natural selection, to the highly adapted multicellular organisms.

Man as an org is selfish, individualistic and dominated often by the old brain and its emotional attributes. Man as a unit in the epiorganism is altruistic, cooperative, and depends on the functioning of his new brain and its intellectual attributes. But the subordination of the old by the new is not yet sufficient. Human nature is evolving but is doing so less rapidly than is the epiorganism in which it expresses itself. Altruism is not yet generalized to the full group, to the whole human epiorganism, but only to the larger subordinate groups based on race or religion or state. As the units given adherence have grown, so have the conflicts between these units become more massive and devastating; and perhaps still other wars on a still greater scale are to be encountered on the path to world integration. But ultimately this integration must be achieved and conflicts of the present type become impossible.

The new brain, the cerebral cortex, is evolving continuously and greatly under the influence of education, which profits by cumulative social achievement; the world is ever more at our individual doors, and cooperation is being generalized to larger and larger groups; mankind as a whole will become an integrated cooperative unit; and the ultimate future of human society, however dark it may look to the contemporary sociologist or even to the historian, appears in the eyes of the biologist, sighting down the long perspective of organic evolution, as bright with hope.

HOW PLANT BREEDING PROGRAMS COMPLICATE PLANT DISEASE PROBLEMS

By Dr. NEIL E. STEVENS

PROFESSOR OF BOTANY, UNIVERSITY OF ILLINOIS

THE present interest in breeding crop plants, together with present means of wide and prompt dissemination of new varieties bids fair to still further complicate disease problems, whether of control, prediction or even of estimation. Given a fairly stable agriculture based on varieties long established in a region, serious fluctuations in the severity of a disease, the kind which are of great economic importance and incidentally of much scientific interest, usually were induced in one of two ways—a marked change in the weather for a longer or shorter period, or the appearance, by hybridization or mutation or by actual introduction, of a new parasite. So generally has this been the case that some pathologists have found an apparent relation between the age of an agriculture and the losses from plant disease. To these students it has seemed that plant disease losses were greater in the regions of newer agriculture.

The list of tragic losses in important economic plants due to introduced insect pests and plant diseases is a long one, too well known to need repetition here. Of the converse process, a serious outbreak of a disease or an insect pest following the introduction of a susceptible variety into the domain of a potentially serious parasite, the history of the potato beetle is perhaps the best known example.

If the historical accounts are correct, the potato beetle acquired its appetite for potato plants very soon after the introduction of the new host. The corn-borer was apparently more deliberate and according to Wardle,[1] "We have historical evidence that the corn-borer thirty years ago was in southern Germany a pest of hemp and hops, and that since its adaptation to corn, it will not seriously attack hemp and hops, even when these plants are grown in close proximity to heavily infested corn fields." Of course, the slightly more than four centuries during which corn had then been cultivated in Germany is really a short time compared with the more than forty centuries which DeCandolle believes hemp had been cultivated, but it is entirely too long to be regarded as a practicable test or quarantine period.

To these two well-recognized methods by which the incidence of losses due to disease and insect pests is strongly influenced, namely, weather changes and introduction, there is now being added, I believe, a third, the work of the plant breeders. It may be worth while to consider future possibilities on the basis of past performance, the only method yet devised for any intelligent appraisal of the future.

On the basis of past performance we may reasonably expect interesting developments in the distribution of disease-producing organisms. As an example of this may be cited the case of the introduction into the northern states of the nematode which causes summer dwarf of strawberries. In the spring of 1930 strawberry plants of the then new and highly regarded variety, Blakemore, were shipped from a region where this type of strawberry dwarf was com-

[1] R. A. Wardle, "Problems of Applied Biology." 1929.

mon[2] to many points outside its known range. Apparently no complete survey has been made since 1931, but the subsequent careful work of Christie[3] leaves little doubt that the disease then introduced into the eastern shore of Maryland is gradually becoming less abundant.

Now that breeding for disease resistance attracts so much attention, we must expect the introduction and rapid dissemination of varieties very resistant to certain diseases. Examples of this are easily recalled. Since they represent a distinct economic gain and disturb no one but the student of plant diseases, they get much attention elsewhere and require little here.

Two closely related results of breeding programs which seem worth special consideration are the introduction on a commercial scale of varieties very susceptible to certain, sometimes new, diseases and the modifying effect of new varieties on parasites long known to be of commercial importance.

At first sight, to speak of the introduction on a commercial scale of varieties very susceptible to certain diseases may seem like a criticism of our breeding programs, but it is not so intended. I struggled with this problem for several years, and became convinced that with our available knowledge, it simply is not possible to so fully test our new varieties as to offer assurance that some of them will not sooner or later prove very susceptible to some disease. This should not be interpreted as condoning any laxity in tests for disease resistance which, of course, should be conducted with all possible completeness and severity, but the number of potential pests is so great and the conditions under which they might become serious so varied that any all-inclusive test would take so long and require culture under so wide a range of environmental conditions as to be wholly impracticable. Just as the real test of a new model of automobile is the road test in the hands of the first twenty to fifty thousand owners, so the real test of a new variety is its culture in the hands of ten to twenty thousand farmers.

As evidence on this point, I would like to quote from the summary given by Stakman, Christensen and Becker[4] of the experience in the spring wheat area of the United States of America during the last 25 years. These writers say, "During the time of observation at least twenty new varieties of wheat were introduced into the spring wheat area and almost every one brought new disease problems with it, or at least changed the old ones." As specific examples they point out that for many years Haynes, Glyndon and Preston were the wheat varieties commonly grown. Stem rust and bunt were then the only really important diseases. When Marquis replaced these varieties over a wide area bunt no longer played any role and stem rust seemed somewhat less serious, but scab, which earlier did not have any significance, suddenly became predominantly important, since the new variety was much more susceptible to this disease.

Somewhat later Hope and H–44, neither of which is in the opinion of these authors a very good variety, were introduced. These are in general more resistant to most of the harmful diseases of spring wheat than any other varieties now available, and are being extensively used for crossing. However, there appears to be a strong linkage in many of these crosses between rust resistance and susceptibility to black chaff to which Hope and H–44 are much more susceptible than any other spring wheats which have been observed up to that time. Just as the wide-spread planting of Marquis made scab of real economic importance, so the wide-spread planting of Hope and H–44 might make black chaff of real economic importance.

In the same paper these authors review the situation regarding barley and state that the disease problem in the case of this crop has changed repeatedly with the introduction and culture of new varieties. In discussing the varieties Velvet and Glabron, which were introduced in 1926, they say "but after these varieties were generally grown for several years it was observed that they were very susceptible to loose smut and scab (p. 62). This latter disease is dangerous because it not only greatly lessens the yield in the case of an epidemic, but also makes the variety useless for feeding to swine because of its toxicity (p. 63).

What may perhaps be regarded as the converse of the relation just described is the effect on parasite populations resulting from the introduction of new host varieties, varieties which by their popularity replace those previously grown and thus make inevitable the development of certain strains of these parasites previously so rare as to be insignificant or even unknown. Here again the work of Stakman and his associates furnishes a good example. Who can fail to connect the increase in form 56 from 0.2 per cent. of the rust population in 1930 to 30 per cent. of that population in 1934 with the coincident great increase in the planting of Ceres wheat, first released in 1926, to which variety stem rust proved so disastrous in 1935?

In considering future possibilities regarding plant diseases it would be folly to exclude what is in some ways the most significant and far-reaching change in a crop plant in our generation, the very general plant-

[2] N. E. Stevens and P. V. Mook, *Jour. Econ. Entomology*, 25: 447–454, 1932.

[3] J. R. Christie, *Jour. Agric. Res.*, 57: 73–80, 1938 (and earlier papers therein cited).

[4] E. C. Stakman, J. J. Christensen and Hanna Becker, *Der Zuchter*, 10: 57–68, 1938.

ing of "hybrid" corn. Unless you live in the corn belt it is difficult to comprehend the speed and extent of the spread of the vogue of hybrid corn. According to Dr. McCall's report to the chief of the Bureau of Plant Industry, 1939, the approximate acreages of hybrid corn were 500,000 in 1935, 1,500,000 in 1936, 3,500,000 in 1937 and 17,000,000 in 1938. In 1939 at least 25,000,000 acres of corn in the corn belt were planted to hybrid seed.[5]

It seems hardly possible that so profound a change can be made without altering the disease relations of the crop. This replacing of open-pollinated corn with hybrid corn fits into the problem we have under consideration in at least three ways. First, in the matter of introducing new varieties very susceptible to certain diseases. If any one imagines that the new varieties, or at least new numbers, of hybrid corn introduced into the corn belt during 1939 and 1940 were so thoroughly tested that their disease relations could be predicted, his knowledge of human nature is even more limited than his knowledge of corn diseases. Nor need we wait for the distant future or for the action of unknown diseases on untested hybrids for evidence of extreme susceptibility. Witness, for example, the havoc worked in Hybrid 960 during 1938 by bacterial wilt and Diplodia stalk rot.

Two of the most experienced entomologists in the Middle West assure me that a somewhat similar condition has been noted with relation to at least one insect. According to these observers, the corn leaf aphid, *Aphis maidis* Fitch, was of relatively minor economic importance for many years prior to the introduction of hybrid corn. During recent years, however, with the introduction of a number of very susceptible hybrids the importance of this insect has greatly increased.

What about the effect of hybrid corn on corn parasites? The change in wheat rust in response to the change in the host population was made possible by the variation continually going on in the stem rust organism itself. Corn parasites vary too, some of them, no doubt, even more actively than in any wheat parasites. That the organism which causes bacterial wilt of corn is made up of a large number of strains, among which there is definite selection on repeated passage through a resistant host, has been proved by McNew[6] and by Lincoln.[7] McNew has further shown that slightly virulent cultures become more virulent after they have grown on certain media.[8]

Just how different the host environment of the wilt organism is in the northeastern sweet-corn-growing states from its environment in the same region ten years ago can be understood only if we review the history of Golden Cross Bantam. This is a single cross made up of two inbred lines, Purdue 39 and Purdue 51. In 1931 seed of this extraordinary hybrid, developed by Glenn M. Smith, was distributed to 61 interested growers in 20 states. Its progress since that time may be best traced from the details in Table 1.

Year	Golden Cross bantam seed produced in pounds	Yellow corn canned		Proportion of all sweet corn hybrids used for canning which were Golden Cross Bantam Per cent.
		Open pollinated Per cent.	Hybrid Per cent.	
1932 ..	2,000	..	..	..
1933 ..	350,000	69	31	..
1934 ..	600,000	57	43	67
1935 ..	1,250,000	38	62	73
1936 ..	1,500,000	27	73	72
1937 ..	1,500,000	21	79	70

These figures were taken from reports of the Raw Products Bureau of the National Canners Association. Accurate figures for subsequent years are not available and may never be since there is a suspicion that Golden Cross Bantam is now being produced and sold under other names.

Not less remarkable than the rapid increase in total acreage is the wide range throughout which Golden Cross Bantam proves to be adapted. It is now in successful large-scale commercial production from Illinois east to and including New York and south through Maryland. Indeed in Maryland it makes up about 40 per cent. of the total crop of sweet corn for canning, although open pollinated Golden Bantam was given up there prior to 1930 because of bacterial wilt. Golden Cross Bantam is now being grown successfully on a commercial scale in Oregon and Eastern Washington and in Western Idaho, though that is not important in the present relation.

The important point here is that from Illinois to the eastern seaboard, throughout practically all the region in which bacterial wilt was so destructive on sweet corn in 1931–1933, its host environment, so far as sweet corn is concerned, has become quite different. Instead of open-pollinated corn, so variable as to become locally adapted and not profitably planted far from the point of production, we have a very uniform single cross dominating sweet corn production over at least a thousand mile belt. Given a parasite which we know to be highly plastic, can any reasonable person assume that the population of this organism to-day can be the same as in 1931?

At some risk of seeming to attempt the dramatic I would like to emphasize the fact that the past decade is the first in the history of agriculture when one could speak of the modification of a corn parasite by a uniform host environment on a scale large enough to

[5] H. A. Wallace, *New Republic*, November 8, 1939.
[6] G. L. McNew, *Phytopath.*, 27: 1161–1170, 1937.
[7] R. E. Lincoln, SCIENCE, 89: 159–160, 1939.
[8] G. L. McNew, *Phytopath.*, 28: 769–787, 1938.

be readily observed, and expect to be taken seriously. I believe it may be literally true that never before in the history of corn culture has a corn parasite been exposed over a wide range to so uniform a host environment. Biologically, including of course its disease relations, we are transforming Indian corn from a freely cross-pollinated crop to a synthetic product.

Elsewhere I have pointed out a relation[9] which may indeed have been all but self-evident, namely, that among comparable crops there is a demonstrable difference as regards disease losses between open-pollinated crops produced from seed and similar self-pollinated crops, disease losses fluctuating more and being in general of greater importance in those plants which are largely self-pollinating.

In a field of open-pollinated corn, there is, I am told, even in the named varieties a wide range in genetic composition and, no doubt, also variation in susceptibility to many diseases. In such a field there is an observable variation in the time of silking and tasseling, and in the time at which plants reach a stage of susceptibility to infection by certain diseases. In contrast to this a field of "hybrid corn" is much more uniform in these respects.

To be sure, the corn now planted consists mostly of double crosses which are somewhat more variable in time of silking, etc., than single crosses. Certain careful growers also plant two crosses in a single field in order that they may still further reduce the hazards due to too great uniformity.

More important in relation to disease and disease-producing organisms is the fact that up until the last few years Indian corn apparently has been able to vary and adjust itself about as rapidly as the disease organisms themselves. Recent researches have shown that in general the common smut of corn, like most smut fungi, is parasitic only in the dicaryon stage, that is, it must cross to parasitize; that it is extremely heterozygous for many characters and consequently unstable; that variation is so common, even in unisexual lines, that from a single monosporidial line more than 150 distinct variants have been isolated; that different combinations of monosporidial lines differ greatly in their degree of pathogenicity and that some of them are so virulent as to kill the host outright.

No one supposes that this ability of the smut fungus or other fungi is recently acquired. It is very much more likely that the process has been going on for many centuries. It is hardly to be doubted that exceedingly virulent lines of smut may occasionally have appeared during these centuries, yet Indian corn survived and has been grown during recent years with a minimum of effective disease control, and apparently much less loss from disease than in the case of wheat.[10]

In corn we are dealing with a native plant, or at least one long cultivated in this area. In many of the places where we now grow corn, our Indian predecessors grew the same plant, which held its own against these same diseases when our ancestors were suffering from the black plague or arguing about the Post-Columbian pandemic of syphilis. All that is now changed and I believe permanently changed. Hybrid corn is here to stay. The increased yield, together with the ease with which seed is produced, makes its future all but certain. Almost equally certain seems to me the probability that we are changing the disease relations of this great crop.

By the wide use of hybrid corn we are depriving this important crop of its power of taking care of itself and by continued crossing and variation, continually adjusting itself to the equally variable parasites which attack it, and have substituted our own choice of parents for each field. In view of our none too brilliant record of success in so testing varieties of other grains as to insure them against loss from disease when planted over a wide acreage, it seems unlikely that we will have much greater success in dealing with corn. It seems much more probable that in spite of the best efforts of the breeders we will see for some years in hybrid corn a disease relation more nearly resembling that in wheat; that is, wider fluctuations in losses with some years very little damage and in others greater damage than has heretofore been observed. Eventually we may see lower average disease losses, but I sincerely believe that our corn breeders will be doing all that can reasonably be expected of them, if during the next ten years they keep the losses from disease in the new varieties, including losses in decay after harvesting, down to the general level of such losses in the old open-pollinated varieties.

OBITUARY

LAWRENCE JOSEPH HENDERSON
1878–1942

LAWRENCE JOSEPH HENDERSON, Abbot and James Lawrence professor of chemistry and chairman of the Society of Fellows in Harvard University, was born in Lynn, Massachusetts, on June 3, 1878. He died suddenly on February 10, 1942.

During the school years in Salem, his home contributed a code of behavior which persisted through life and an awareness of the learning of that day.

[9] N. E. Stevens, SCIENCE, 89: 339–340, 1939.

[10] N. E. Stevens, *Scientific Monthly*, 52: 364–366, 1941.

Through his father's business interests in the island of St. Pierre, he early established an affectionate and lasting intimacy with France. In school, mathematics, which in later years served both as a tool and for relaxation, was easy; the only teacher whom he remembered with satisfaction taught him physics.

At the age of sixteen, he entered Harvard. Here it was possible for him to form habits of independence of thought and action which in college kept him from accepting the dicta of instructors or his fellows unthinkingly; in later years these habits were characteristic. An unorthodox performance of an experiment in physical chemistry produced unexpected results and persuaded Professor T. W. Richards to permit an investigation of their nature. As early as his sophomore year he had decided to enter biological chemistry, although no courses were offered in the college; and about this time he apparently began his thinking about the acid base equilibrium. Here he learned and mastered the generalizations of physical chemistry, then approaching its full vigor. As evidence for his understanding; he submitted an essay on Arrhenius' theory of electrolytic dissociation for a Bowdoin Prize Contest. Later, his knowledge bore much more valuable fruit.

Having received his A.B. degree in 1898, he took the generally accepted approach to biological chemistry and entered the Harvard Medical School, receiving his M.D. degree in 1902. But he never felt himself completely a medical student and lived in Cambridge, where began the friendships which were to lead for a time to an interest in philosophy. His medical studies were, however, by no means sterile. He learned the meaning of the Hippocratic teachings, acquired a thorough sense for biological phenomena, was initiated into problems which later deeply concerned him, and formed associations with physicians which he always treasured.

The years 1902–1904 were spent in Hofmeister's laboratory in Strassburg. And although they contributed little to his formal training, the associations with future leaders in physiology and biological chemistry did leave an impress and led to persistent friendships. There, too, his interest in hemoglobin began. He also observed a German university tradition already past its prime. And especially, he noticed certain German traits, among them an undiscriminating liking to obey authority, which later became generally offensive. Accentuated in Alsace-Lorraine, these traits produced a deep emotional impression upon him.

He returned to Harvard in 1904 as lecturer in biological chemistry, and soon decided that investigations of the acid base equilibrium were likely to prove more fruitful for him as a biological chemist than thermochemical studies chiefly concerned with the relation of heats of combustion to molecular structure. And so the next decade was devoted to studying the mechanisms involved in neutrality regulation in the animal organism and their explanation in quantitative physico-chemical terms, according to the theory of dissociation of weak acids. Meanwhile, his deeper curiosity, insight and a sense of order led him to perceive that "fitness is a reciprocal relation between an intricate pattern of properties of organisms . . . and an intricate pattern of properties of water, carbon, dioxide, and the compounds of the three elements, hydrogen, oxygen, and nitrogen."[1] This led to writing "The Fitness of the Environment," published in 1913. In 1917, influenced by the Royce Seminar, a more complete understanding of Willard Gibbs's study "On the Equilibrium of Heterogeneous Substances," and by his own habits of reflective contemplation and search for underlying uniformities, he completed "The Order of Nature." These books mark a turning point in his career, as he no longer felt constrained to concern himself only with the conventional application of physical to biological chemistry.

After a war-time digression into the physical chemistry of bread-making, he turned in 1919 to his important physiological studies. Already aware that numerous functional relationships existed in blood, he took advantage of the team spirit generated during war and led a group of investigators, already interested in the subject, simultaneously to investigate the variables involved. Before long it became possible to analyze the system in Gibbs's terms and to describe the simpler relations graphically with the aid of elementary mathematics. It was, however, necessary for him to learn and apply d'Ocagne's method of nomographic representation in order to reveal clearly the complex interrelationships. Although these studies continued until 1930, a synthesis was presented at Yale in the Silliman Lectures of 1928 and published as "Blood—A Study in General Physiology."

But several years before, about 1926, William Morton Wheeler had brought the Italian economist and sociologist, Pareto, to his attention. The "Traité de Sociologie Generale" had impressed Henderson as an accurate qualitative description and a workable classification of the uniformities found in all observed social systems. Once aware of its importance, he was impelled to master it by eager study, to lead others to an understanding of its implications and to test its validity. After 1930 his efforts wholeheartedly served these ends. By 1935 his last published book, "Pareto's General Sociology—A Physiologist's Interpretation," had appeared. A collection of privately distributed lectures and excerpts for use in the course, "Sociology 23—Concrete Sociology," indicates the intensity and

[1] L. J. Henderson, unpublished "Memories."

extraordinary range of his reading and observation. Although the analogy of social systems to Gibbs's systems did not escape him, he realized that the time for quantitative treatment was not yet at hand. Without it, he was able to explain many phenomena observed in everyday relations between two or more persons, or between groups of individuals, in terms of the persistent uniformities which are the manifestations of sentiments. He increasingly stressed the study of man through concrete cases, and in 1941 appropriately emphasized this point of view in a course given to first-year students at the Harvard Medical School.

Next to his intellectual pursuits, his relations to Harvard University were his most important interest for three quarters of his life. Eight years a student, he served it devotedly in the usual sequence of academic posts for thirty-nine years. He gave formal instruction in three subjects: biological chemistry, 1904–1939; history of science, 1911–1942; and sociology, from 1932–1942. All his courses had one common characteristic—they reflected the progress of his thinking. For example, in 1912 he read a large part of "The Fitness" to his class in Chemistry 15 before he had finished the book. Thus he managed to preserve vigor and freshness in each of these courses over extended periods, and because of the unusual breadth of his learning, students gained not only special knowledge, but also were given an insight into the cultural meaning of science.

With graduate students he practiced a policy that amounted almost to *laissez-faire*. An enrichment of their ideas was inescapable, as informally he generously and sympathetically applied the "eager clarity of his mind" to the innumerable intellectual and personal problems presented by curious young men. And he ever strove to induce them to develop the best in themselves.

His leadership was recognized in that he was enabled to establish the Laboratory of Physical Chemistry at the Medical School in 1920 and the Fatigue Laboratory at the Business School in 1927. Convinced that investigators should ordinarily master their own destinies, he gradually withdrew from the active direction of both laboratories. He did, however, continue his direct association with the Fatigue Laboratory to the end.

For a number of years President Lowell and Henderson had discussed means of aiding the development of original scholars. Consequently, the Society of Fellows was founded in 1933 with Henderson as its first chairman. It came to reflect many of his beliefs. Here a group of most promising young men, stimulated by interaction with each other and with a few of the university's most distinguished professors, learned of dignity and breadth in scholarship, became aware that human relationships were important, and were given a period of freedom from academic and financial pressure so that some might, through reflective thought, experiment or writing, fulfil the promise of productive scholarship.

It was inevitable that his contributions to knowledge and his own increasing wisdom should receive recognition; the former by honorary degrees, lectureships, and memberships in learned societies, and the latter by appointment to important committees. The latter responsibilities he undertook with energy and with characteristic persistence, if at all. As Foreign Secretary of the National Academy of Sciences, he had, with the Foreign Secretary of the Royal Society, arranged the Pilgrim Trust Lectureship before war broke out; recently he was actively concerned with Inter-American relations.

But it was at his camp in Morgan Center, Vermont, that the many facets of his personality shone most clearly. His love of symmetry appeared in the buildings he had designed; his love of beauty in nature as he sat on the porch gazing at the gentle scene before him. Here his essential kindness and human interest were manifest not only to invited friends but to neighbors of the countryside. This place he loved. Here he thought, worked and contemplated the world in serene inquiry.

Altogether, his life, which he had made so rich, satisfactory and stimulating, exemplifies the concept of the complex interactions of organism and environment to which his experimental studies, continued observations, unusually wide reading and contemplation had led him. Although he undoubtedly would have minimized the magnitude of his influence on the environment, it is apparent in the importance of his publications, through his formal teaching, and less apparent, but probably even more important, in his human relations, especially with young men, his leadership in institutions and the deep and abiding affection of those who had come to know him well.

RONALD M. FERRY

RECENT DEATHS

DR. C. HART MERRIAM, founder in 1885 and until 1910 chief of the United States Bureau of Biological Survey, now known as the Fish and Wild Life Service, until three years ago research associate of the Smithsonian Institution, died on March 19 at the age of eighty-six years.

PROFESSOR ADAM C. DAVIS, JR., head of the department of experimental engineering at Sibley College, Cornell University, died on March 17 at the age of fifty-two years.

FRANCIS IRENEE DU PONT, research chemist, died on March 16 at the age of sixty-eight years. He was known for his discoveries in the field of smokeless powder and for his development of the minerals separation process.

ISABEL BEVIER, until her retirement with the title emeritus in 1922 professor of home economics and head of the department at the University of Illinois, died on March 17 in her eighty-second year.

WHARTON HUBER, curator of mammals in the Academy of Natural Sciences of Philadelphia, died on March 12. He had been a member of the staff of the academy since 1921.

SCIENTIFIC EVENTS

THE COMING HARVEST IN THE UNITED KINGDOM

A WIRELESS dispatch from Raymond Daniell to the *New York Times* reports that the British Minister of Agriculture, Robert S. Hudson, stated on March 18 in the House of Commons that the future history of Britain and perhaps of the world might depend on this year's harvest in the United Kingdom. He pointed out that meat supplies are dwindling and the shortage of merchant tonnage is becoming more acute; the nation is depending more and more on vegetables, and he made it clear that the advice of the Minister of Foods, Lord Woolton, to make up deficiencies in diet with vegetables could not be followed unless larger harvests from land already cultivated could be obtained.

Experts from the United States will go to England for consultation in an effort to increase production. Mr. Hudson stated that nearly all arable land is already in use, but that there is a shortage of manpower. There are more than 25,000 women enrolled in the agricultural army and it is still growing, but use will have to be made of school children and Italian war prisoners.

More than 80 per cent. of the farms consist of less than 150 acres. Many farmers earn little more than the laborers they hire to work in their fields. At the close of this ploughing season the tilled fields will amount to 6,000,000 acres more than before the war. The 1938 potato acreage of 700,000 acres already had been increased by more than 1,000,000 acres and will be further increased this year. Vegetable production generally had been increased from 2,500,000 to 4,000,000 tons. Oat and sugar-beet production also had been greatly increased. Germany had 70,000 tractors working on 4,000,000 farms in 1939, while Great Britain had 50,000 on 500,000 holdings. Mr. Hudson stated, however, that Germany was making poor progress in increasing the farm output of the occupied countries. Meats in Great Britain are now scarce, and the ration probably will have to be cut even further. Fuel and light soon will be rationed, and it is expected that for part of the time there will be no hot water.

REPORT OF THE TREASURER OF YALE UNIVERSITY

THE expenditures of Yale University for the fiscal year ended June 30 were $9,517,376, according to the annual report of George Parmly Day, treasurer of the university. Of this amount, $7,890,088 was for educational purposes, and the balance of $1,627,288, for the operation of the dining halls, the Athletic Association and maintenance of plant. The total income available was $9,492,005, leaving a deficit of $25,371.

Included in the income mentioned were gifts to the university from the Alumni Fund of $323,472 to meet current expenses, an increase of $2,062 over last year. Since its founding, the Alumni Fund, which was organized to raise endowment and provide funds for current expenses for the university, has made available $7,954,255 for income and has accumulated a principal of $5,664,568.

Yale paid out $6,312,249 in salaries to about 3,300 persons in and around New Haven—faculty and administrative and service employees—who constitute the university payroll, and to local firms for materials and services, $1,973,558, bringing the total expenditures made in New Haven to $8,285,807.

Statistics included in other parts of the report show that the twelve dining halls operated by the university served 1,665,978 meals during the year, and the weekly board rate, unchanged since 1933, is $8 for 21 meals; the University Library, with expenses of $494,007, added 106,000 volumes to its collections, bringing the total number of books to more than 3,000,000; the Athletic Association had expenses of $438,033 and income of $397,693, which left a deficit of $40,340.

The report listed gifts and bequests for endowment, exclusive of contributions to building funds, aggregating $1,994,019, bringing the total endowment to $112,096,810. Income derived from productive assets amounted to $3,932,964—an average return of 4.34 per cent. (The average was 4.32 per cent. in 1940, 3.97 per cent. in 1939 and 4.31 per cent. in 1938.)

Among the principal items of income listed in the

report are: from investments and fiduciaries, $4,057,-233; tuition, $2,198,527; gifts available for expenses, $1,063,629; and net income from dormitory room rents, $416,576.

JUNIOR ENGINEERING STUDENTS AND THE WAR INDUSTRIES

CONSULTATION with government and industrial officials has led the faculty of the College of Engineering of New York University to adopt a new accelerated war training program that will free trained junior engineering students for four months service with war industries by the middle of May. Under the plan, third-year students who have completed all the basic engineering studies will be released at that time to work with war industries for four months during the spring and summer; and the academic program of undergraduates will be accelerated by the elimination of most of the regular holidays during the academic year. As has previously been announced, some two hundred and fifty present seniors will complete their studies next month.

Under the continuous summer study program adopted by many engineering schools, no additional engineering personnel will be available much before next February. Approximately 1,100 engineering students will be affected by the war program at the college, with 250 juniors and some sophomores available to war industries this summer.

An important aspect of the newly adopted program will be the availability of the college classrooms and laboratories during the summer for defense research and for the continuance and expansion of the various government training programs now being conducted for the Army Air Corps, Ordnance Department, Signal Corps, Weather Bureau, Navy, U. S. Office of Education and other government agencies. In one instance alone, this will make possible an increase of 150 per cent. in the training of personnel for an important military bureau.

The plan includes an academic speed-up from September to April, makes the third-year students available for work in war industries this summer, and yet graduates the class of 1943 only two months later than does the modified speed-up or continuous summer study program, adopted by many institutions. The four months summer work experience will familiarize students with industrial procedures and practices. Employment in industry between the junior and senior years thus saves a corresponding amount of time after graduation.

The accelerated academic program, together with the plan for the production assistance to war industries, makes possible a year-round utilization of facilities, without depriving industry of much-needed personnel during the spring and summer.

Preliminary surveys among personnel directors of aeronautical firms in the East indicate that the eighty junior aeronautical engineers enrolled in college would probably all be placed on or before May 15, and reports from other sources indicate that there may be a larger demand for junior electrical engineers for the four-month period than the college will be able to meet. The demand for student engineers in other fields is also heavy. The students affected by the program at the college are studying administrative, aeronautical, chemical, civil, electrical and mechanical engineering and meteorology.

The students, after completion of summer work in war industries, will resume classes about September 15, and the returning fourth-year men will be graduated in April, 1943. The present sophomores, according to the plan, will be available for the next four-month employment period by May 15, 1943.

THE FINNEY-HOWELL RESEARCH FOUNDATION

AT the meeting of the board of directors of the Finney-Howell Research Foundation held in February, eight fellowships were awarded for the period of one year. These are:

Julius C. Abels, B.S., M.D., to work at Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York, N. Y.

Glenn Horner Algire, M.D., to work at the National Cancer Institute, Bethesda, Md.

Bernerd E. Kline, B.S., M.S., to work at McArdle Memorial Laboratory, University of Wisconsin.

Margaret Nast Lewis, A.B., Ph.D., to work at the Crocker Radiation Laboratory, University of California at Berkeley.

Alfred Marshak, B.S., Ph.D., to work at Crocker Radiation Laboratory, University of California at Berkeley.

Rose I. Shukoff, M.D., to work at the Glasgow Royal Cancer Hospital, Glasgow.

Emilia Vicari, to work at the Roscoe B. Jackson Memorial Laboratory, Bar Harbor.

Benjamin Norman Horwitt, B.S., Ph.D., to work at Harvard University, Converse Memorial Laboratory.

Applications for next year must be in the hands of the secretary of the foundation by January 1, 1943.

THE PERMANENT SCIENCE FUND OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

INCOME from the Permanent Science Fund, according to agreement and declaration of trust, shall be applied by the American Academy of Arts and Sciences to such scientific research as shall be selected ". . . in such sciences as mathematics, physics, chemistry, astronomy, geology and geography, zoology, botany, anthropology, psychology, sociology and eco-

nomics, history and philology, engineering, medicine and surgery, agriculture, manufacturing and commerce, education and any other science of any nature or description, whether or not now known or now recognized as scientific, and may be applied to or through public or private associations, societies, or institutions, whether incorporated or not, or through one or more individuals."

Applications for grants under this indenture are considered by a committee of this academy on stated dates only. The next meeting to consider applications will be held on October 1. Applications should be made on special forms furnished by the committee. Correspondence, including requests for application blanks, should be addressed to the chairman of the Committee on the Permanent Science Fund, Professor John W. M. Bunker, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Grants-in-aid from this fund recommended by the committee were announced by the academy on March 11 as follows:

To Elso S. Barghoorn, Jr., instructor in biology, Amherst College, for miscellaneous expenses of field work and laboratory study of the structural changes in submerged wood and plant remains, $335.

To Thomas H. Bissonnette, professor of biology, Trinity College, Hartford, Conn., for expendable materials and assistance in a further study of photo-periodicity in animals, $400.

To Bart J. Bok, associate professor of astronomy, Harvard University, for the construction of a 26-inch circular mosaic grating to be used with a 24-inch Schmidt telescope, a joint project in collaboration with Dr. R. W. Wood, of the Johns Hopkins University, $750.

To Vernon I. Cheadle, assistant professor of botany, R. I. State College, for assistance in continuing a study of the conducting systems in the Monocotyledoneae, $350.

To Clark Goodman, research associate, the Massachusetts Institute of Technology, for construction of equipment to be used in continuation of a study of the locus and relative concentration of elements in ores by the use of induced radio-activity, $650.

To Cornelius S. Hurlbut, Jr., associate professor of mineralogy, Harvard University, for construction of equipment to be used in a study of refractive indices of amphibole and other minerals, $450.

To Fred M. Uber, assistant professor of physics, University of Missouri, for reagents for use in study of synthesis of kojic acid by microorganisms using C^{13} as a tracer, $425.

THE NUTRITION FOUNDATION

THE appointment of Ole Salthe, formerly consultant for the Federal Food and Drug Administration, as executive secretary of the Nutrition Foundation, Inc., organized by fifteen food manufacturers, as reported in SCIENCE for January 16, to study nutrition for the improvement of public health, has been announced. Scientific and industrial advisory committees have also been appointed. The foundation has headquarters at the Chrysler Building.

Members of the scientific advisory committee are:

Dr. F. G. Boudreau, director, Milbank Memorial Fund; Dr. C. A. Elvehjem, University of Wisconsin; Dr. Icie M. Hoobler, Children's Fund of Michigan; Dr. P. E. Howe, the Surgeon General's office, U. S. Army; Dr. E. V. McCollum, the Johns Hopkins University; Dr. L. A. Maynard, Cornell University; Dr. J. R. Murlin, the University of Rochester; Dr. Roy C. Newton, Swift and Company; Dr. Lydia J. Roberts, the University of Chicago; Dr. W. C. Rose, the University of Illinois; Dr. W. H. Sebrell, U. S. Public Health Service; Dr. Henry C. Sherman, Columbia University; Dr. F. F. Tisdall, the University of Toronto, and Dr. R. R. Williams, Bell Telephone Laboratories.

Members of the food industries advisory committee are:

Dr. Roger Adams, the University of Illinois, representing the Coca-Cola Company; H. A. Barnby, Owens-Illinois Glass Company; Dr. Frederick C. Blanck, the H. J. Heinz Company; Dr. Laurence V. Burton, "Food Industries"; Dr. Charles N. Frey, Standard Brands, Inc.; Frank L. Gunderson, the National Research Council; Dr. W. H. Harrison, the Continental Can Company; Norman F. Kennedy, the Corn Industries Research Foundation; Dr. Edward F. Kohman, the Campbell Soup Company; Donald Maveety, the National Biscuit Company; Dr. Robert W. Pilcher, the American Can Company; Dr. G. L. Poland, the United Fruit Company; Alan C. Richardson and James McConkie, the California Packing Company; Dr. E. H. Robinson, Swift and Company; Dr. James A. Tobey, the American Institute of Baking, and Lewis W. Waters, the General Foods Corporation.

SCIENTIFIC NOTES AND NEWS

THE Borden Company Prize of $1,000 of the American Chemical Society for "outstanding research in the chemistry of milk" has been awarded for 1942 to Dr. George E. Holm, biochemist of the Bureau of Dairy Industry of the U. S. Department of Agriculture, in recognition of "his contributions to the understanding of the basic causes and the control of oxidative deterioration of fats and oils, and to the prevention of spoilage of dairy products caused by the oxidation of milk fat." Leroy S. Palmer, professor of agricultural biochemistry at the University of Minnesota, was chairman of the committee of award, other members of which included Dr. Roy C. Newton, chief chemist of Swift and Company, Chi-

cago, and Dr. R. Adams Dutcher, head of the department of agriculture and biochemistry at Pennsylvania State College.

JOHN D. ROCKEFELLER, JR., has been awarded the medal of honor for city planning in recognition of "his unique services to professional ideals." The medal was presented to Mr. Rockefeller at his offices on March 10, together with a scroll commending his "broad vision and initiative." "They have enabled him to plan numerous civil projects, the influence of which has been inspiring to the present generation and the effect of which will shape and help to determine the constructive forces of the future." The citation was signed by the presidents of the societies making the award: Harvey Stevenson, New York Chapter, American Institute of Architects; Joseph Mathieu, Brooklyn Chapter, American Institute of Architects; Michael Rapuano, New York Chapter, American Society of Landscape Architects, and Dean G. Edwards, Metropolitan Section, American Society of Civil Engineers.

THE Joseph A. Capps Prize in medical research for 1941 has been awarded to Dr. Arnold Lazarow for his study on "Particulate Glycogen: a Submicroscopic Component of the Guinea Pig Liver Cell; its Significance in Glycogen Storage and the Regulation of Blood Sugar."

DR. DINSMORE ALTER, director of the Griffith Observatory, Los Angeles, has been awarded the degree of doctor of science by Monmouth College, Illinois.

DR. ARNO B. LUCKHARDT, professor and chairman of the department of physiology, School of Medicine, University of Chicago, has been elected an honorary member of the St. Louis Medical Society.

AT the forty-seventh annual meeting on March 13 and 14 of the Michigan Academy of Science, Arts and Letters, officers were elected for the coming year as follows: *President,* H. R. Hunt, Michigan State College; and from the University of Michigan, *Vice-president,* Malcolm H. Soule; *Secretary,* Harry W. Hann; *Treasurer,* Mischa Titiev; *Editor,* Henry van der Schalie; *Librarian,* Warner G. Rice. General addresses were delivered by Dr. I. D. Scott, professor of geology at the University of Michigan and president of the academy, and by Dr. A. F. Blakeslee, of the Carnegie Institution, Cold Spring Harbor, N. Y.

DR. WILFORD ARLESS RISTEEN, Rochester, N. Y., has been appointed professor and head of the department of neurologic surgery at the University of Georgia School of Medicine, Augusta. He succeeds the late Dr. Richard Frank Slaughter.

PROFESSOR S. W. EDGECOMBE, horticulturist in the extension staff of Iowa State College, has been appointed associate professor in plant science at the University of Manitoba.

DR. FRANK RIECKEN, of the University of Illinois, has been appointed research assistant professor of soils at Iowa State College.

A REVISION in organization has been effected throughout the University of Oklahoma by the action of the new president, Joseph A. Brandt. The titles of all department heads have been changed to chairmen, and general changes in personnel have been made correspondingly. The former heads of departments retain their professorships and salaries. In the scientific departments the new appointments are as follows: *Botany and Bacteriology* (to be called Plant Science), Dr. G. L. Cross is replaced by Dr. Milton Hopkins as chairman; *Chemistry,* Dr. Guy Y. Williams by Dr. Bruce Houston; *Physics,* Dr. H. L. Dodge by Dr. G. A. Van Lear; *Psychology,* Dr. L. B. Hoisington by Dr. M. O. Wilson; and *Zoology* (now consolidated with physiology, of which Dr. Alma J. Neill had been acting head, as the Department of Animal Biology), Dr. A. Richards by Dr. A. I. Ortenburger.

DR. HUGH H. YOUNG, editor of the *Journal of Urology,* having reached the age of seventy-one years, will retire on July 1 as professor of urology and as director of the Brady Urological Institute at the Johns Hopkins Hospital. He plans to keep an office in the Brady Institute and to devote himself to clinical research and writing.

THE council of the Zoological Society of London has temporarily suspended the position of secretary of the society, held by Professor Julian Huxley, "because of financial stringency owing to the war." Professor Huxley has been criticized in the House of Commons for opinions expressed during his visit to the United States.

DR. WILLARD C. RAPPLEYE, commissioner of hospitals of New York City since October, 1940, has resigned to return to his work as dean of the College of Physicians and Surgeons of Columbia University. Dr. Rappleye, who succeeded Dr. S. S. Goldwater as commissioner, had planned to retire in January, but was persuaded by the mayor to remain in office somewhat longer.

DR. FRED L. ADAIR, Mary Campau Ryerson professor of obstetrics and gynecology and chairman of the department of the School of Medicine of the University of Chicago, has become chief of the State Division of Maternal and Child Hygiene.

THE editorship of the *Journal of Parapsychology* has been changed. For the past three years, Dr.

Gardner Murphy, of the College of the City of New York, and Dr. Bernard F. Riess, of Hunter College, have edited it. The editorship of the *Journal* now returns to Duke University, where it was first started. The new editors are Drs. J. B. Rhine, Charles E. Stuart and J. G. Pratt, with Dr. J. A. Greenwood as statistical editor.

JULIAN F. SMITH will relinquish his work as associate director of the Hooker Scientific Library at Central College, Fayette, Mo., of which Dr. Neil E. Gordon is director, to become technical librarian and editor of publications of the Institute of Gas Technology. To give him time to make the change the Institute of Gas Technology has arranged to divide his time between the two institutions for several months. He will continue later to act in an advisory capacity.

DR. GEORGE S. MYERS, professor of biology and head curator of zoological collections of Stanford University, will leave in June for a year's study and travel in Brazil, under a grant from the State Department in Washington. Dr. Myers will make his headquarters in the Museu Nacional in Rio de Janeiro, where he has been requested to present a series of lectures on Brazilian fishes and fisheries resources and to take charge of the advanced training and research of a selected group of Brazilian ichthyological students. He will also travel in different parts of the country to study fishes and fisheries industries.

THE *Journal* of the American Medical Association reports that the Second U. S. Army General Hospital Unit, consisting of fifty-five members of the staffs of the College of Physicians and Surgeons, the School of Dental and Oral Surgery and the Columbia-Presbyterian Medical Centers, Columbia University, have been called to active duty. The chief of the surgical service is Dr. W. Barclay Parsons, associate professor of clinical surgery, and the chief of the medical service is Dr. Yale Kneeland, Jr., assistant professor of medicine, both of whom are lieutenant colonels. Other members of the faculty have been granted leave of absence to enter active service with the Medical Corps of the Army and Navy.

DR. H. M. TYSDAL, agronomist, of the division of forage crops and diseases of the U. S. Department of Agriculture, and of the department of agronomy of the College of Agriculture, University of Nebraska, gave the eleventh series of Frank Azor Spragg Memorial Lectures at Michigan State College early in March. The memorial lecture proper dealt with "New Aspects of Forage Crop Improvement." The four other lectures were on related subjects.

THE seventh Leo Loeb Lecture under the annual lectureship which has been established by the Mu Chapter of the Phi Beta Pi Medical Fraternity was delivered on March 23 by Dr. John Herr Musser, professor of medicine at Tulane University, at the Washington University School of Medicine, St. Louis. He spoke on "The Heart That is Getting Old."

THE sixtieth course of popular medical lectures of the School of Medicine of Stanford University will be given on April 3 and 17 and May 1 and 15. These are as follows: "The Blood Bank," Dr. John R. Upton; "Medical Aspects of Civilian Defense," Dr. Anthony J. J. Rourke; "Alcohol in Relation to Driving Hazards," Dr. Henry W. Newman; "Control of Venereal Disease under War Conditions," Dr. Charles W. Barnett.

DR. J. O. PERRINE, assistant vice-president of the American Telephone and Telegraph Company, gave a lecture-demonstration on March 26, entitled "The Electrical Voice," before the Lancaster Branch of the American Association for the Advancement of Science.

THE forty-second annual meeting of the American Association of Pathologists and Bacteriologists will be held at the Washington University School of Medicine, St. Louis, on April 2 and 3.

THE thirty-fifth annual meeting of the International Association of Medical Museums will be held at the Washington University School of Medicine, St. Louis, on April 1, under the presidency of William H. Feldman, Rochester, Minn.

THE thirty-seventh annual meeting of the American Association of Museums will be held at Colonial Williamsburg, Virginia, on Monday and Tuesday, May 18 and 19.

THE Pennsylvania Academy of Science will hold its eighteenth annual meeting at the Edinboro State Teachers College, Erie Co., Pa., on April 3 and 4. The Junior Academy will hold its meetings at the same time and place. Dr. A. Glenn Richards, Jr., of the University of Pennsylvania, will give the principal address. He will speak on "The Present Status of Electron Microscopy in Biology."

DURING the meetings of the Federation of Societies of Experimental Biology and Medicine, in Boston, the Boston and Cambridge Branch of the American Association of Scientific Workers is planning a threefold program of special interest to biologists and medical men. On Wednesday, April 1, at 8:00 P.M. a public lecture will be held at Littauer Center in the Harvard Yard, Cambridge. The speaker will be Dr. C. C. Little, director of the Cancer Research Laboratory at Bar Harbor, Maine, whose subject will be "The Social Implications of Cancer Research." On Friday, April 3, two meetings will be held in Room 22 at Boston

University College of Liberal Arts (corner of Boylston and Exeter Streets). In the afternoon a series of scientific films will be shown between 4:45 and 5:45. At 8:00 P.M. of the same day, again at Boston University, there will be held a symposium on "Biology and Medicine in the War." Among those participating are Dr. Maurice B. Visscher, of the department of physiology of the University of Minnesota; Dr. Lucien Brouha, formerly of Liége, Belgium, and now of the Harvard Fatigue Laboratory; Dr. C. W. Walter, of the Harvard Medical School, and Dr. Harry Grundfest, of the Rockefeller Institute for Medical Research. All members of the federation and others in the Boston area are invited to attend.

DISCUSSION

ON THE STRIDULATIONS OF INSECTS

RECENTLY some articles have appeared on the effect of temperature on the stridulations of crickets. My interest in temperature control, stimulated by some of these reports and the presence of a very noisy insect in our back yard, prompted me to make some observations as described in the following paragraphs.

The insect was of the genus "Oecanthus" of the order "Orthoptera" and seemed to maintain a location of about three feet above the ground in the middle of a Spirea bush. A mercury thermometer was placed at the edge of the bush near the same level as the insect. The number of stridulations per minute were counted manually and record made of the temperature, simultaneously. Readings were taken every day from August 12 to September 10, the temperature passing through a range of 55 degrees to 85 degrees (F) during this period. The stridulations commenced at seven P.M., and this starting period did not vary more than five minutes on successive evenings. From about seven to seven-thirty o'clock the stridulations were quite irregular with interruptions occurring every half minute. After about seven-thirty they would proceed without interruption until the early hours of the morning. A total of 100,000 stridulations would occur on a warm night (no time out for lunch) as a fair estimate.

Data were taken at nine o'clock each evening in the interest of uniformity, as by that time the fall of temperature due to the setting of the sun had reached a point where the temperature gradient between the thermometer and the insect would be reduced to a minimum.

Observations, as shown by the graph in Fig. 1, indicate a very definite relation of periodicity of stridulation and ambient temperature. It is probable that sensitive recording apparatus would show a more uniform relation. Readings taken on different days at the same temperature were in close agreement. At 55 degrees the low limit of stridulatory power was reached, and the magnitude of the sound at this temperature was quite reduced from normal. At 54 degrees no audible sound was present. The points on the graph enclosed by circles were observations taken on a similar insect, August 23, at River Forest, Ill. The points coincide with the curve, showing a remarkable duplicity in insect life.

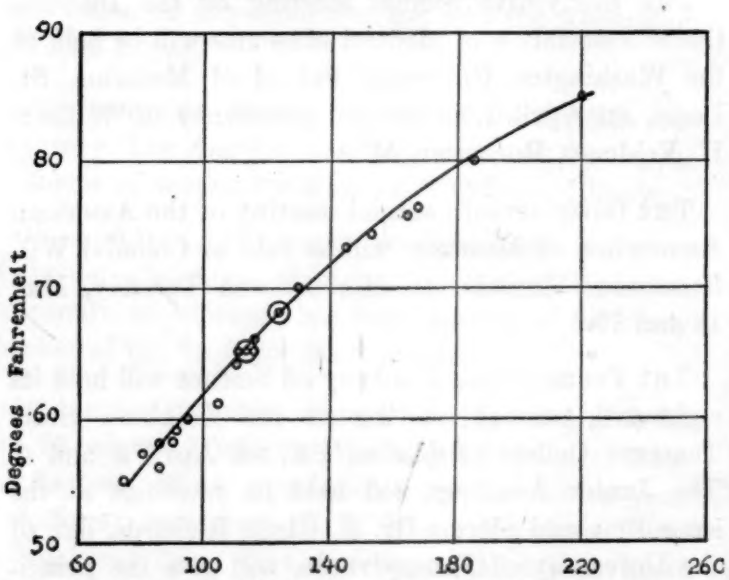

FIG. 1. Graph showing relation of stridulations of tree cricket (Oecanthus) to ambient temperature changes, readings taken each night from August 12 to September 10, 1941.

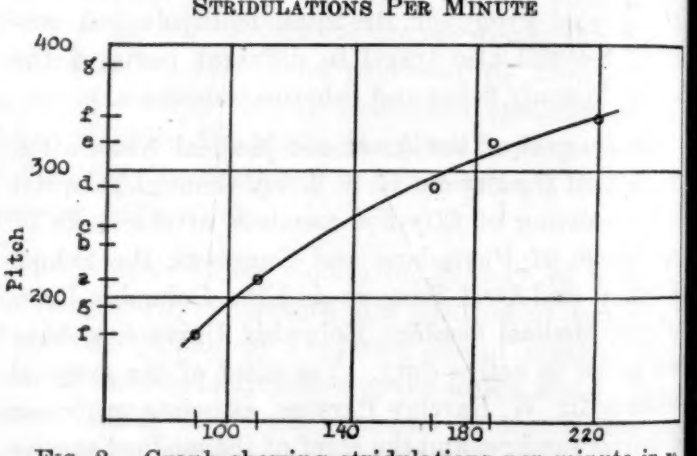

FIG. 2. Graph showing stridulations per minute in relation to pitch as compared to keys on piano. The numbers on the abscissa are vibrations per second and the keys are indicated in their approximate relation to this vibration. The keys plotted are those that came nearest to be in union with the pitch of the stridulation. (The key c is middle c on piano.)

The stridulation seems to be made up of two move-

ments. There is an outward movement of the wings at each stridulation, and as the movement reaches maximum position, membranes in the wings vibrate. The graph shown in Fig. 2 indicates the pitch of the stridulation in reference to its periodicity. As the pitch was determined from keys on the piano some variation could be expected as the key indicated was chosen as being nearest to the pitch. It will be noted that a range of one octave on the piano was covered by a change in temperature from 59 degrees to 85 degrees. From the data it is evident that the mechanism that moves the wings as well as the membranes in the wings are very sensitive to temperature, and response to temperature changes is of marked uniformity.

HOWARD D. MATTHEWS

DETROIT, MICH.

THE RELATIVE EFFECTS OF ANOXIA

BECAUSE of recent interest shown in the problem concerning the relative effects of anoxia upon old and young animals, a reference by Moreland[1] to the work of Buffon, of LeGallois and of Edwards[2] should be brought to more general attention. Interest in the work of these early investigators lies in the fact that many recently reported results are substantially in agreement with results reported 125 years ago.

J. M. JOHLIN

SCHOOL OF MEDICINE,
VANDERBILT UNIVERSITY

CALENDAR REFORM AND 364-DAY YEARS

IN SCIENCE of February 20 it is stated that present calendar defects make the arrangement of schedules for industry and education difficult and temporary only, also that there can be no doubt about what would happen in calendar reform, if scientists had their way. A large percentage (76 per cent.) gave affirmative answers to the question whether or not a revised world calendar of 12 months and equal quarters should be adopted.

Some years ago when the Eastern Orthodox Churches changed to our Gregorian calendar, a clause was added expressing hope that Western nations might soon be ready to improve that calendar.

The World Calendar involves the interpolation each year of a so-called *Year day* or *extra Saturday*.

In this connection the possibility of making the astronomical year coincide with the calendar year might be considered. If the change to a calendar year with 12 months and equal quarters is made, the first years might be assigned only 364 days, omitting the disputed *Year day*. After eight such years, the winter solstice (occurring now about December 21) would coincide with the *Year day*. Thereafter the calendar quarters would correspond approximately to the astronomical quarters. The period of eight years would give the world time to experience the greater convenience of the new calendar. Before the end of that period many people might come to favor the new plan who now have never heard of it or are skeptical.

January 1, 1943, comes on a Friday; two years later, on a Monday. With ideas changing from national to international along many lines, perhaps we may now also think about the coming world calendar. To take away a day a year need be no more disturbing than the present adding a day in leap years. We have recently witnessed the ease with which the whole United States can drop or add an hour on a specified day.

ALFRED GUNDERSEN

BROOKLYN, N. Y.

A STUDY OF FAUNAL DISTRIBUTION

I SHOULD like to take the opportunity of acknowledging in SCIENCE the generous support that E. P. Mumford, of Jesus College, Oxford, and I have received in America in connection with a cooperative study of faunal distribution with particular reference to oceanic islands. This comprehensive study of island populations seeks to promote a wider approach to the basic problems of the origin of species. It was initiated at Oxford in October, 1938, with the aid of grants from the Higher Studies Fund, the Royal Society and the British Association for the Advancement of Science. Since the war, the work has been carried on by Mr. Mumford as a member of the faculty at Stanford University, California, in association with Oxford, with the aid of supplementary grants from the Carnegie Corporation of New York, the National Academy of Sciences, the American Philosophical Society, the American Association for the Advancement of Science, the Society of Sigma Xi and the May Esther Bedford Fund, Inc. Mr. Mumford and I are deeply indebted to these organizations for their support as well as to the officers and trustees of Stanford University, where he has been extended every facility in the prosecution of his researches. Among the scientists at Stanford who have been most helpful, mention should be made of Dr. Ray Lyman Wilbur, chancellor of the university, Professor C. V. Taylor, Professor Eliot Blackwelder, Professor E. G. Mears and Dr. H. A. Spoehr, director of the Carnegie Institution there. Thanks are due also to Dr. Frank Aydelotte, of Princeton University, and the Rhodes Trust, for unfailing support.

In view of the importance of Anglo-American rela-

[1] F. B. Moreland, A thesis presented to the faculty of Vanderbilt University, 1936.

[2] W. F. Edwards, "On the Influence of Physical Agents on Life." Translated from the French by Hodgkin and Fisher and published by Haswell, Barrington and Haswell, Philadelphia, 1838.

tionships, it is perhaps of interest to note that Mr. Mumford first went to America with one of the Commonwealth Fund Fellowships, designed for the promotion of "mutual amity and understanding between Great Britain and the United States," after which he was invited to accept the directorship of the Pacific Entomological Survey (*Nature,* 141, 196, 1938). This position he held until he came up to Oxford, at the invitation of my predecessor, Sir Edward Poulton, as a Leverhulme research fellow.

It is to be hoped that this project now being carried on in association with Oxford and Stanford Universities will not only serve the advancement of science as such, but also aid the promotion of cordial relationships between English and American scientists interested in the basic problems of evolution.

G. D. HALE CARPENTER,
Hope Professor of Zoology (*Entomology*)
UNIVERSITY MUSEUM,
OXFORD, ENGLAND

SCIENCE TWENTY-FIVE YEARS AGO

THE RELATIONS BETWEEN ENGINEERING AND SCIENCE[1]

As engineering adopts the knowledge which science has correlated it simultaneously unearths new uncorrelated knowledge. Science indeed correlates this in turn, but not instantaneously, so that engineering has always at its hand both that which science has correlated and its own empirical discoveries which science has not yet had time to arrange. As optimists we may well expect that this uncorrelated knowledge will form a gradually decreasing fraction of the whole, but can we expect it ever to vanish completely? Must not science's approach to exclusive leadership be asymptotic?

We begin to get a glimmering of the vastness of the scheme of creation when we remember that every lengthening of man's artificial vision by means of telescope and camera, every new strengthening of telescope, sensitizing of plate, and lengthening of exposure brings a proportional increase in the number of visible suns, telling us that even at that inconceivable distance we have not begun to approach the limit of the discoverable universe. When we turn from telescope to microscope and thence to the inferred constitution of matter, we find with every new refinement of observation and inference a proportional addition of new wonders, a proportional increment in the complexity of natural phenomena. Hence while we may speculate that, as there must be a place where the stars end, so there must be a degree beyond which the subdivision of matter can not go, and a limit to the number of nature's laws, we may well ask whether either that limit or the limit of stellar space will be reached in that little throb in the pulse of the universe which we call the habitable period of this earth. Will man survive long enough to complete the discovery of all laws, so that no uncorrelated phenomena will remain for the engineer to unearth?

The second of the two considerations which tend to postpone the completion of science's leadership is that the beautiful as distinguished from the useful and the good will increase without limit its demands upon the work of the engineer. Though the beautiful itself should in time be capable of complete mathematical analysis, who shall say that that time, now seemingly so inconceivably remote, can arrive during man's earthly stay?

HENRY M. HOWE

[1] Concluding part of the introductory address of the chairman of the Section of Engineering of the American Association for the Advancement of Science, New York, December 29, 1916, printed in the issue of SCIENCE for March 23, 1917.

OUR PSYCHOLOGICAL ASSOCIATION AND RESEARCH[1]

IT is our business as individuals and especially as united in this American Psychological Association to use all possible efforts at all times, in all places and in all ways to improve the conditions under which research work is done. Science has doubled the length of human life and quadrupled the productivity of labor. A single advance in applied science, such as the Bessemer steel process or the electromagnet, discovered by Faraday in the only research laboratory then existing, may add annually some two billion dollars to the wealth of the world. The psychological and social sciences have already done their share in freeing us from superstition and unreason, in leading us to tell the truth as we see it and in some measure to see the truth as it is. They have repaid many fold their cost in economic applications. An improvement of ten per cent. in the educational work of this country saves us a hundred million dollars a year. But it is to the future that we look to obtain a control over human conduct corresponding to that of physical science over the material world, and more vital. We must eliminate the incalculable waste of preventable idleness, misfit employment, disease, vice, crime and war; we must divide wealth more fairly and use it more wisely, we must alter fundamentally all our institutions, the family, the church, the school, the

[1] Concluding paragraph of the address given on the occasion of the twenty-fifth anniversary of the American Psychological Association, New York, December 29, 1916, printed in the issue of SCIENCE for March 23, 1917.

courts, government and the rest; each must be enabled to give what he best can and to receive what he most needs. And, as I said twenty-two years ago—before that "infant industry" eugenics had begun its career—in my address as president before this association:

> We not only hold the clay in our hands to mould to honor or dishonor, but we also have the ultimate decision as to what material we shall use. The physicist can turn his pig-iron into steel, and so can we ours; but he can not alter the quantities of gold and iron in his world, whereas we can in ours. Our responsibility is, indeed, very great.

J. MCKEEN CATTELL

NOTES

THE portrait by Henry Ulke of Joseph Henry, first secretary of the Smithsonian Institution, has been transferred by a senate resolution, from the Capitol to the Smithsonian Institution, where it has been hung in the National Gallery of Art, in the new building of the National Museum.

DR. ALEXANDER GRAHAM BELL, inventor of the telephone, was awarded the Civic Forum Gold Medal for distinguished public service in New York on March 21. The presentation address was made by Dr. John H. Finley, state commissioner of education. Dr. Bell is the third recipient of the medal. It was awarded to Major General George W. Goethals in 1914, and to Thomas A. Edison in 1915.

DR. WILLIAM H. WELCH was the guest of honor at the tenth annual banquet of the Æsculapian Club, Philadelphia, on February 6.

THE portrait of Professor R. D. Salisbury, planned for by his former students, was presented to the University of Chicago on the afternoon of February 8.

THE Adams prize at Cambridge has been awarded to J. H. Jeans, M.A., sometime fellow of Trinity, for an essay on "Some Problems of Cosmogony and Stellar Dynamics." No election has been made to the Isaac Newton Studentship.

PROFESSOR A. N. WHITEHEAD has been elected president of the British Mathematical Society.

THE membership of the Botanical Committee of the National Research Council has just been completed, as follows: From the National Academy, J. M. Coulter (chairman), D. H. Campbell, R. A. Harper; from the American Association for the Advancement of Science (Committee of One Hundred), George T. Moore, B. E. Livingston, L. R. Jones; from the Botanical Society of America, Erwin F. Smith, Edward M. East and H. H. Bartlett.

DR. FABIAN FRANKLIN, associate editor of the New York *Evening Post* since October, 1909, has resigned. Dr. Franklin was professor of mathematics in the Johns Hopkins University from 1879 to 1895.

DR. ROBERT GRANT AITKEN, astronomer in the Lick Observatory, has been granted by the University of California four months' leave of absence to go to the Atlantic coast to complete arrangements for the publication of his work on the double stars.

PROFESSOR WALDEMAR LINDGREN, of the Massachusetts Institute of Technology, has gone to Chile in connection with geological work on some of the copper properties.

DR. JOSEPH A. BLAKE, formerly professor of surgery in Columbia University, who has rendered distinguished services at Neuilly and at Ris-Orangis, has accepted an invitation from the French government to become head of the great Doyen Hospital.

DR. CHARLES D. WALCOTT, secretary of the Smithsonian Institution, has been elected chairman, and Dr. S. W. Stratton, of the Bureau of Standards, secretary of the military committee of the National Research Council.

SCIENTIFIC BOOKS

CYTOLOGY, GENETICS AND EVOLUTION

Cytology, Genetics and Evolution. By twelve authors. Philadelphia: University of Pennsylvania Press. 168 pages, 19 figures. 1941.

THIS little book represents a survey of the subject as a part of the bicentennial celebration of the founding of the University of Pennsylvania. The papers are grouped into four departments, with three in each group: Chromosomes and Heredity, Cytogenetics and Evolution, Cytology and Genetics of Protozoa and Physiology of the Nucleus. The contributors and their subjects run as follows with a brief summary quoted in each case:

Demerec, M. "Nature of the Gene." "Thus an attractive possibility is open for speculation that each salivary band may consist of a single molecule, which is repeated a great many times, the length of the molecule determining the width of the band."

Metz, Charles W. "Chromosome Structure." "No one knows just what a chromosome is or how it is constituted."

Schrader, Franz. "The Sex-chromosomes, Heteropycnosis and its Bearing on Some General Questions of Chromosome Behavior." "The evidence from a wide range of cases strongly indicates that during a certain period of the meiotic prophase there is a defi-

nite and specific tendency for all heterochromatin to come together."

Blakeslee, Albert F. "Cytogenetics and Evolution." "Interchanges are only one of the types of chromosome alteration which have evolutionary significance."

Dobzhansky, Th. "Chromosome Differences between Races and Species of Drosophila." "It seems justifiable to conclude that, with the exception of translocations, all the types of chromosome changes which are known to differentiate its species are met with in races as well."

McClung, C. E. "Evolution of the Germ Plasm." "We are certain of the continuity of germ plasm, and of the general nature of the material record of racial experience. It seems evident that the hope for an understanding of racial and individual development waits upon a fuller knowledge of the nature and behavior of the visible elements which embody the germ plasm."

Jennings, H. S. "Hereditary Status of Rhizopods." "There is nothing known as to Mendelian heredity in Rhizopods. There is no knowledge of inheritance and variation in sexual reproduction. . . . It deals with heredity and variation in reproduction from a single parent, in vegetative reproduction. . . . There remains the question: Is it the chromosomal materials, is it the genes that become altered when hereditary diversities are produced in a single clone through the action of the environment or otherwise? Jollos is of the opinion that it is *not* the chromosomal materials that are altered."

Diller, William F. "Nuclear Behavior and Reproduction in Ciliated Protozoa." "Underlying all the apparent diversity and variability of nuclear phenomena one comes to discern a fundamental similarity whose expressions are differences in degree and not in kind."

Sonneborn, T. M. "Inheritance in Ciliated Protozoa." "I have reviewed in this paper some situations in ciliate genetics, in which typical genetic inheritance is unquestionably involved, but I have also attempted to set forth a number of situations, including by far the greater part of what is known about ciliate genetics, which are extremely difficult to interpret along orthodox genic lines. . . ."

Churney, Leon. "The Physico-chemical Properties of the Nucleus." The author discusses the properties under the headings: Colloid chemical properties of the nucleus and cytosome, viscosity, osmotic properties of the nucleus, permeability of the nuclear membrane to water, amphoteric properties of the nuclear constituents.

Duryee, William R. "The Chromosomes of the Amphibian Nucleus." "Facts such as these offer strong support to commonly accepted genetic theory, that master molecules or molecular templates, as genes have been called, remain imbedded in the axis cylinder, ready to divide in mitosis and become distributed for work in some future cell."

Henshaw, Paul S. "Radiation and the Cell Nucleus." "As a consequence the exponential dose-action curves, in so far as they are reliable, may be taken to indicate that biologic changes as extensive as cell death may be induced by single event action—perhaps even by the production of single ion pairs."

These authors present a brief summary of important problems in their fields. The tentative nature of the subject is indicated strongly and the line of future work pointed out. Naturally, in so diversified a subject, there is lack of agreement, but it is surprising to see how far it really obtains on broad general principles. There is, for instance, practically no disagreement with regard to the chromosome theory of inheritance. Expressed or implied, it lies at the basis of each paper. In view of the fact that the subject of cytology is but seventy-five years old, and modern genetics but forty years, this is not a bad record. As presented in the symposium here it offers a very hopeful prospect for future developments.

C. E. McCLUNG

OCCUPATIONAL DISEASES

Occupational Diseases. Diagnosis, Medico-legal Aspects and Treatment. By RUTHERFORD T. JOHNSTONE. 558 pp. Philadelphia and London: W. B. Saunders Company. 1941.

THIS is an excellent book written by a man who has had years of experience not only in the diagnosis and treatment of a wide variety of industrial diseases but also in that newer and increasingly important field, the dealing with claims for compensation. The book covers the most important industrial poisons; the dusts, injurious and inert; the dermatoses; injuries from physical agents, and there is also a chapter on "the industrial back" and on hernia, and a full discussion of traumatic neuroses and malingering.

A chemist would be puzzled over the choice of title for the first section, "Gases, Solvents and Fumes," and still more by the groupings under this title. The halogenated hydrocarbons are scattered through five chapters, instead of being treated as a group, and such diverse bodies as nitrobenzene, dichlorofluoromethane and ethylene dichloride are grouped together. However, this does not really produce confusion and is of minor importance. What is of major importance is Dr. Johnstone's selection of material. He very wisely gives little space to the earlier literature, which is abundantly covered in the older textbooks, and instead covers fully the very latest contributions. This is especially well illustrated by the chapters on

benzol, carbon tetrachloride, carbon disulfide and carbon monoxide.

The material for the book was gathered in a clinic which for 25 years has offered medical and surgical industrial service and which evidently is a consultative center for a large part of California, handling some 11,000 patients a year. It was opened soon after the passage of the Workmen's Compensation Act, which covered diseases of occupation as well as accidents, and thus, from the first, this aspect of industrial medicine was of great importance and recurs again and again in the discussion of individual cases. Dr. Johnstone's attitude toward the medico-legal problems is eminently fair, free from over-indulgence but equally free from a hard-boiled scepticism. It is evidently the result of long experience on a mind free from prejudices and is perhaps most clearly shown in the section on neuroses and malingering.

A mild criticism might be made of one or two subjects. Nitrous fume poisoning is rather too briefly handled, considering its great importance in the production of high explosives and in welding. The diagnosis of lead poisoning, based on history of exposure, clinical symptoms and laboratory findings, is very well dealt with, but the picture given under the heading "Suggestive evidence of incipient intoxication and inactive or arrested plumbism" would by many physicians be called "definite and active plumbism," requiring suspension from lead exposure, even if no disability is found. It seems to this reviewer that the connection between chronic plumbism and peptic ulcer, nephritis and vascular damage is dismissed too lightly in view of the available evidence.

There are indications of rather hasty preparation in some places (talc is included among the silica-containing dusts on page 307, but correctly classed as hydrated magnesium silicate on page 305) and the proofreading is surprisingly faulty for a Saunders book; "consistency" for "constituents," "ascribed to" for "described," and one whole line misplaced on page 335.

One very good feature of the book remains to be mentioned, the sections on treatment, which are detailed and clear, not general and vague as is too often true in books of this kind.

ALICE HAMILTON

DIVISION OF LABOR STANDARDS,
WASHINGTON, D. C.

REPORTS

GRANTS MADE BY THE BANTING RESEARCH FOUNDATION

THE Banting Research Foundation reports that grants made to individuals working on medical problems in different parts of Canada last year were instrumental in furthering research of considerable interest in several fields. Following are brief summaries of work performed by those holding grants during part or whole of last year.

To test the accepted hypothesis that oxidation of α-estradiol to estriol, or hydration of estrone to estriol, takes place in the uterus under the influence of progesterone, W. S. Bauld, of Dalhousie University, working with Dr. R. D. H. Heard, showed that in the rabbit this transformation occurred.

W. H. Feindel and Dr. C. B. Weld, at Dalhousie University, studied the permeability of the eye membranes in dogs to the sugars xylose, glucose, sucrose and raffinose. It was found that their penetration into the aqueous humor was inversely related to their molecular size, and that raffinose represents the approximate limit of the size of the molecule which passes through the membranes.

Dr. K. C. Fisher, of the University of Toronto, extended his investigation of the mechanism of the action of anesthetics to include a broad variety of narcotic agents and cells. The initial interpretation, namely, that the metabolism of a cell is separable into two independent parallel fractions, has been fully borne out.

A. G. Gornall, of the University of Toronto, found that in ureasynthesis studies the accumulation of citrulline occurred in liver slice saline containing $NH_3 \cdot CO_2$, lactate and ornithine. This research forms an important step in our knowledge of the means by which urea is formed in the body.

Dr. Mavis Gunther, of the University of Toronto, has made a survey of the progress of lactation in a series of women. She has accumulated statistics of when and why infants are weaned and has analyzed the causes of women being unable to nurse satisfactorily.

M. M. Hoffman, of Dalhousie University, working with Dr. R. D. H. Heard, has furnished experimental confirmation of the hypothesis that the urinary oestrogen, oestrone, arises in the body from the ovarian follicular hormone, α-oestradiol. The metabolism of the corpus luteum hormone was also investigated and it was found that in the rabbit, as in the human, pregnane-3 (α), 20 (α)-diol is the main excretory product and the conversion in the rabbit is not appreciably affected when the uterus is removed.

A. F. McKay, of Dalhousie University, working with Dr. R. D. H. Heard, continued investigations dealing with the degradation of cholesterol to Ring B substituted androgens, with the object of elucidating

the structure of certain isomers of androsterone excreted during pregnancy in the mare.

Miss M. M. MacKenzie, of the University of Western Ontario, studied the relation of age of rats to susceptibility to cancer induced by benzanthracene. She found younger rats more susceptible than older ones, but the strain of the rat was found to be much more important than its age or sex.

Miss D. B. Mundell, of the University of Toronto, has devised a simple method for the purification of tissue cholinesterase from dog pancreas. One milligram of the purified esterase hydrolyses 4–5 grams of acetylcholine per hour. This degree of purity is about 100 times greater than that obtained by Stedman.

Dr. L. T. Newman and Messrs. W. A. Ladd and J. H. L. Watson, of the University of Toronto, worked on several applications of the electron microscope to medical research. With Dr. D. Irwin, a study was made of the size of the particles of mine dust, and it was found that particles 0.03–0.20 microns in diameter were much more numerous in drilling than in blasting dust. With Dr. J. Craigie, School of Hygiene, University of Toronto, several hundred photomicrographs of vaccina virus, typhoid bacillus, rickettsia and bacteriophage were taken.

Miss H. M. Perry, of the University of Toronto, performed experiments which showed that the lessened carbohydrate stored in scorbutic conditions was due to inanition and not to the deficiency of vitamin C. A peculiar condition of fat storage in vitamin C deficiency was substantiated, but fatty or cirrhotic livers were not observed. Experiments also showed that the capillary fragility is not a good index for the clinical estimation of either vitamin C or P deficiency.

H. C. Read, of Dalhousie University, found that the X-zone of the adrenal glands of the mouse degenerate during pregnancy and will regenerate after pregnancy but that regeneration is delayed by lactation. In immature animals the X-zone can be made to disappear by injections of oestrone, testosterone, A.P.L. and P.M.S. hormones.

Dr. K. Sternbach, of the University of Toronto, tested the activity of 104 new compounds of the sulfanilamide type, prepared by Dr. Schnitzer, against meningococcus infection. Ten showed definite activity but no more than that of drugs already known. Of a smaller series of drugs prepared by Dr. Siebermann, two were found which were as efficacious as sulfanilamide with regard to meningococcus infection and were decidedly less toxic. Dr. Sternbach has also obtained a method of infecting animals with gonococci, so that sulfanilamide compounds could be tested against this type of infection in animals.

Dr. P. G. Weil, of the Royal Victoria Hospital, Montreal, has made further studies with regard to the histamine content of blood and tissues in shock. He has also investigated the value of certain substitutes for whole fresh blood in the treatment of the condition.

The trustees wish to point out that in addition to financially assisting the above-described individual researches, the foundation gave a block grant, amounting to almost half the income of the foundation, to the Banting and Best Chair of Medical Research, University of Toronto.

The trustees wish to remind medical research workers in Canada that funds are available each year to financially assist individuals who submit problems which meet with the approval of the trustees. Meetings at which applications are considered are usually held in May, August and December.

V. E. HENDERSON

THE BANTING RESEARCH FOUNDATION,
TORONTO, CANADA

SPECIAL ARTICLES

THE EFFECT OF COLORED IONS ON THE PHOTO-INACTIVATION OF INVERTASE

AGULHON[1] showed that invertase is inactivated directly by ultraviolet light of wave-length shorter than 3022 Å, while longer wave-lengths have no effect. However, von Tappeiner[2] had shown that the addition of fluorescent dyes to solutions of invertase preparations sensitized the enzyme to the action of sunlight. It seems apparent from these experiments that the radiant energy absorbed by the dye is in some way transferred to the enzyme molecule where it inactivates the prosthetic group. However, the task of proposing a theory of actual mechanism of energy transfers of this type is greatly complicated by the polyatomic nature of the dye molecule, for at least two possibilities exist: (1) the free dye molecule might be activated by light and transfer energy to the enzyme molecule in a collision process; or, (2) the dye molecule and enzyme molecule might form a complex which absorbs light energy, inactivating the enzyme and possibly freeing the dye molecule which may then take part in further inactivations. In a detailed discussion of the available evidence Blum[3] favors the latter mechanism.

[1] H. Agulhon, *Compt. Rend. Acad. Sci.* (Paris), 152: 398, 1911; *ibid.*, 153: 979, 1911; *Ann. Inst. Pasteur*, 26: 38, 1912.

[2] H. von Tappeiner, *Ber.*, 36: 3035, 1903.

[3] H. F. Blum, "Photodynamic Action and Disease Caused by Light," p. 82, Reinhold Publishing Corp., New York (1941).

It seemed desirable to attempt to find out whether some monatomic ion having a suitable absorption spectrum could be found which would sensitize invertase to the action of light; for here, presumably, the first of the above possibilities would not exist. In this paper are reported the results of a preliminary investigation of the effect of certain inorganic ions on the photo-inactivation of invertase.

The enzyme used in this study was a commercial preparation[4] labeled "invertase scales"; it had been obtained from bottom fermenting yeast and contained some melibiase. For each experiment 0.03 gm of this preparation was dissolved in 4 cc of distilled water containing 1 drop of 0.1 N HCl and the desired concentration of the inorganic salt. After the enzyme had completely dissolved, 2 cc of this solution were placed in a quartz test-tube for irradiation and 2 cc served as a control in a glass test-tube of the same dimensions, but wrapped in black paper. Both tubes were then placed at a distance of 10 cm from a glass enclosed Type H-3 General Electric mercury vapor lamp for a measured length of time. The solution in the quartz tube thus received the full radiation from the lamp, while the control in the glass tube was affected only by the heat radiated from the lamp.

Following irradiation, the enzyme solutions were brought to 25° C. and each thoroughly mixed with 10 cc of a 20 per cent. sucrose solution. The rates of inversion of sucrose at 25° C. were then followed simultaneously in the 20 centimeter tubes of two polarimeters.

TABLE I

EFFECT OF COLORED IONS ON THE PHOTO-SENSITIVITY OF INVERTASE

Experiment number	Ion concentration (Mg/cc)	Length of time irradiated (min.)	Degrees of rotation			
			Original	20 min.	40 min.	60 min.
1.	None	0	12.5	8.0	4.6	2.4
		15	12.5	8.0	4.8	2.5
2.	0.1 mg Cu^{++}/cc	0	12.5	6.0	1.25	0.8
		15	12.3	12.0	12.0	12.0
3.	0.1 mg Cu^{++}/cc	0	12.33	7.48	4.15	2.1
		8	12.35	8.12	5.93	3.75
4.	0.4 mg Cu^{++}/cc	0	11.5	9.0	8.4	....
		15	11.5	11.5	11.5	....
5.	0.1 mg Fe^{++}/cc	0	12.3	7.45	3.75	1.25
		15	12.3	7.45	3.80	1.25
6.	0.1 mg Ni^{++}/cc	0	12.1	7.48	3.75	1.20
		15	12.1	7.48	3.98	1.98
7.	0.1 mg Co^{++}/cc	0	12.0	7.47	3.80	2.0
		15	12.0	7.47	3.83	2.38
8.	0.11 mg UO_2^{++}/cc	0	11.25	10.25	10.18	....
		15	11.30	10.31	10.31	....

The results are shown in Table I, which contains in successive columns the number of the experiment, the ion concentration, the length of time of irradiation and degrees of rotation in the polarimeter at various times after mixing the enzyme solutions with sucrose. From the results of Experiment 1 in which no salts were added to the enzyme, it is seen that 15 minutes irradiation of the enzyme alone had no effect on the activity. Experiment 2 shows that, while 0.1 mg Cu^{++} (as $CuSO_4$) per cc has a negligible direct effect on invertase activity, 15 minutes irradiation of a mixture containing this concentration of Cu^{++} results in almost complete inactivation of the invertase. In a supplementary experiment similar inactivation was found to result from 15 minutes irradiation of a solution containing only 0.05 mg Cu^{++} per cc. Experiment 3 shows that an 8-minute period of irradiation of invertase in the presence of 0.1 mg Cu^{++} per cc results in only partial inactivation of the enzyme. Experiment 4 shows that 0.4 mg Cu^{++} per cc partially inactivates the enzyme even without radiation, while irradiation increases the extent of inactivation by this concentration of Cu^{++}.

Experiments 5, 6 and 7 show that the colored ions Fe^{+++}, Ni^{++} and Co^{+++} in concentrations of 0.1 mg per cc bring about negligible inactivations of invertase even when the solutions were irradiated. Uranyl ion as $UO_2(NO_3)_2$ containing 0.1 mg of uranium per cc almost completely inactivates the enzyme; irradiation in the presence of uranyl ion causes still further inactivation. In another experiment Ca^{++} was found to have no effect.

The results suggest that, in order to bring about a photo-inactivation, a monatomic ion must have first, a suitable absorption spectrum, and second, a means of transferring the absorbed energy to the enzyme molecule. It seems probable that the cupric and uranyl ions form complexes with the invertase which, themselves, are capable of absorbing energy and decomposing to form inactive material. It would appear that the other colored ions used were incapable of forming such complexes and were therefore ineffective. Further work will have to be done to elucidate further the mechanism of the reaction.

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[4] From Wallerstein Laboratories, New York, N. Y.

THE OCCURRENCE OF FITS IN PYRIDOXINE DEFICIENT RATS

CHICK *et al.*[1] described fits of an epileptic nature in rats maintained on pyridoxine deficient diets for a period of four months or more. No such fits have been reported in this country, although thousands of

[1] H. Chick, M. M. El Sadr and A. V. Worden, *Biochem. Jour.*, 34: 594, 1940.

pyridoxine deficient rats have been studied. In the laboratory of the Poultry Division, hundreds of pyridoxine deficient rats[2] were studied without the appearance of such epileptic-like fits. Recently, however, fits such as described[1] were observed. The fits occurred among pyridoxine deficient rats, each of which was fed 5 cc of water by stomach tube every 3 hours. After the second water feeding 5 out of 16 rats were observed to go into fits which lasted from a few seconds up to about 2 minutes. Others possibly went into fits but were not observed. Fits developed when the rats were startled by noise or were surprised by being suddenly picked up. Others were nervous but were not observed to go into convulsions. The rats had been on the pyridoxine deficient diet about 4 to 5 months.

Since there is a disturbance of water metabolism in human epilepsy[3] we repeated the experiment, but the fits did not recur. The rats were then exposed to the piercing sounds produced continuously by frequencies of 30 to 10,000 cycles after they had been given water by stomach tube, but the convulsions did not recur.

At about this time, fits were observed in pyridoxine deficient rats in the laboratory of the Vitab Corporation. They were few but in sufficient numbers to arouse interest. These rats were also given water by stomach tube without producing any fits.

After the rats were 6 to 8 months old, convulsions occurred spontaneously with increasing frequency. The convulsions were not alike, but they followed a definite pattern. They generally occurred when several rats were together in a can and frequently handled during the time when they were weighed or the vitamin doses fed. One rat in fits will generally set off other rats in convulsions. Without warning the rat will sometimes start convulsively forward in jerks similar to the hopping of a mechanical rat. Often the rat will paddle the air with its paws. The head is often jerked up into an upward tilt and the rats get up on their hind legs and paddle the air. Sometimes they get up so high on their hind legs that they lose their balance and tumble over backwards or on their sides. When paddling or fanning the air with their paws their ears will sometimes wiggle rapidly, appearing much like a fan without a handle. Sometimes their ears are pressed flat against the back of their necks. While rearing on their hind legs, they will often involuntarily hop in the air, sometimes jumping out of the can. The paddling of the air and the fanning of the ears seemed to be motivated from one source as though controllable by one switch. These involuntary hops gave the appearance of being motivated by a hidden spring in the rat resembling a hopping mechanical rat. Mild convulsions were generally limited to a few convulsive hops or a half minute's pawing of the air often accompanied by the wiggling of the ears. Severe convulsions lasted 2 to 3 minutes. A round drop of saliva sometimes involuntarily appeared at the mouth of the rat during a severe convulsion. After a severe convulsion, the rat would sit or lie perfectly still, sometimes holding the wire screen tightly in the front paws. During this period the rat seemed unconscious and did not react when touched. The only sign of life was the heaving in and out of the sides, the forward part of the rat's body slowly moving forward and backward in rhythm with the heaving in and out of the sides. Occasionally the rats lay on their sides with their legs outstretched as though dead. They came out of this coma-like condition without any apparent effort and scratched themselves behind the ears or washed their faces as though nothing had happened. Occasionally after they had regained consciousness they shook themselves much like a dog just coming out of water.

Convulsions were never observed under 4½ months and then only rarely. When they reached the age of 6 to 8 months they occurred more frequently. Some rats had fits daily. The duration of the convulsions gradually increased. Out of 13 rats 7 months of age 6 regularly had fits. Out of 3 rats 9 months of age receiving 5 micrograms daily of pyridoxine, one occasionally had a short mild convulsion.

We can, therefore, confirm the findings of Chick *et al.*[1] that fits will occur in pyridoxine deficient rats and we wish to suggest the possibility, remote though it may be, that disturbed water metabolism may in some way be involved in the production of these epileptic-like fits.

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[2] S. Lepkovsky, *Jour. Biol. Chem.*, 124: 125, 1938.

[3] C. H. Best and N. B. Taylor, "The Physiological Basis of Medical Practice," p. 1460. Baltimore: Williams and Wilkins Company. 1940.

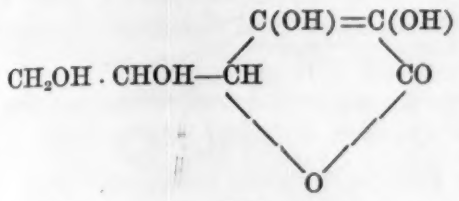
EFFECT OF l-ASCORBIC ACID ON THE ISOLATED FROG HEART[1]

SIMPLE unsaturated lactones like βγ-angelicalactone, αβ-angelicalactone and crotonolactone γ-acetic acid and its esters have a characteristic digitalis-like action upon the frog heart isolated according to the method of Straub. If administered in an adequate concentration and replaced continuously (by means of a special cannula) at a steady rate for a suitable length of time

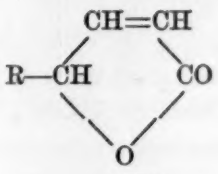
[1] Carried out under the auspices of the University Committee on Pharmacotherapy.

they initially bring about an increase in the amplitude of contraction and eventually lead to an irreversible systolic standstill.[2]

l-Ascorbic acid[3] (I) can be considered as an αβ-unsaturated lactone related in structure to the simple αβ-unsaturated lactones of type (II).



(I)



(II)

When administered into the cannula of the isolated frog heart at an initial concentration of 1:2,000 to 1:50,000 and replaced continuously at a rate of 2–2.5 cc per minute, l-ascorbic acid caused a systolic standstill within a period of from 2 to 5 hours. There was an increase in the rate of the heart. When the ventricle eventually stopped in systole, the auricle continued beating. The initial action of l-ascorbic acid was an increase in the amplitude of contraction. This was observed previously by Urban and Peugnet.[4] They also noted an increase in the diastolic "tonus" but were unable to reproduce this effect consistently.

Our preliminary work indicates that the reaction may be modified by the pH of the physiological salt solution. We have not yet studied how the systolic action is influenced by copper, which Peugnet[5] has found essential for the "beat-strengthening action" of l-ascorbic acid.

Our observations show for the first time that the reported "systolic" action upon the frog heart can be caused by an organic-physiological substance of known chemical structure occurring in the organism of the warm-blooded animal.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE STERILE CULTURE OF PARAMECIUM MULTIMICRONUCLEATA

DURING the last few years protozoologists have recognized more and more the need for sterile culture methods. When it is impossible to culture an organism in the absence of other living cells the rigid control of conditions so necessary in all experimental studies is not possible. Advances in methods of sterile culture of free-living forms offer new possibilities for similar studies on related pathogenic forms.

The establishment and culture of a strain of *Paramecium* that is bacteriologically sterile has frequently been attempted. The only successful cases that have been reported are those of Loefer[1] and Glaser and Coria,[2] in each of which the presence of other living cells was essential. We have established five strains of *P. multimicronucleata* in a yeast juice medium. These strains have been maintained for ten months through 18 transfers. Their sterility has been confirmed, so we wish to report the method used.

The paramecia were obtained from a live yeast stock culture which has been growing in our laboratory since 1937. The organisms were sterilized by a combination of the Claff[3] migration-dilution technique and the Parpart[4] washing technique.

Many kinds of culture media were tried, including peptone media, yeast extracts, yeast autolysates and unheated disintegrated bacteria, all with and without added growth factors. Success was attained only with the pressed yeast juice of Buchner.[5]

The pressed yeast juice is made as follows. One pound of Fleischmann's baker's yeast is ground with an equal weight of washed, fine, white sand. This is then mixed with 125 gms of diatomaceous earth and reground to a sticky dough. This dough is wrapped in two layers of birdseye diaper cloth, which has been dampened with distilled water, and then placed in a 4½″ perforated screw press cylinder. Pressure, by a manually operated screw press,[6] is applied as rapidly as possible.

[2] O. Krayer, R. Mendez, E. Moisset de Espanés and R. P. Linstead, *Jour. Pharmacol. and Exper. Therap.* In press.

[3] l-Ascorbic acid was donated by Hoffmann-La Roche, Inc., Nutley, N. J., and by Merck and Company, Inc., Rahway, N. J.

[1] J. B. Loefer, *Jour. Exp. Zool.*, 72: 387–407, 1936.

[2] R. W. Glaser and N. A. Coria, *Am. Jour. Hyg.*, 21: 111–121, 1935.

[4] F. Urban and H. B. Peugnet, *Am. Jour. Physiol.*, 123: 207, 1938.

[5] H. B. Peugnet, SCIENCE, 90: 162, 1939.

[3] C. L. Claff, *Physiol. Zool.*, 13: 334–341, 1940.

[4] A. K. Parpart, *Biol. Bull.*, 55: 113–120, 1928.

[5] E. Buchner, H. Buchner and M. Hahn, "Die Zymasegärung," pp. 58–66. Münschen and Berlin: R. Oldenbourg. 1903.

[6] A "ten-ton" press made by the Atlas Press Company of Kalamazoo, Michigan, is used.

This procedure yields about 120 cc of yeast juice which is caught in an ice-packed flask and then stored in a refrigerator over night. It is then forced through a Seitz bacteriological filter by pressure. This juice is stored in a refrigerator at all times and is used only after complete sterility tests have been made.

For cultures, 5 cc portions of triple distilled water are sterilized in 18 mm Pyrex culture tubes, and, after cooling, 0.5 cc of the yeast juice is added to each aseptically. These are then ready for inoculation. Tests with a wide range of dilutions indicated that 1:10 is near the optimal concentration.

In all, sixty-one cultures of yeast juice were inoculated with sterile paramecia. From these, five strains were established and successfully maintained. Transfers are made at about 14-day intervals. Sterility tests have been made regularly at every transfer. Most of the common test media have been tried at various times in these tests. The standard testing media now employed consist of: 0.5 per cent. Difco yeast extract plus 0.5 per cent. dextrose; 0.03 per cent. beef extract; Difco nutrient agar plus 0.5 per cent. dextrose; and Brewer's thioglycollate anaerobic medium. Dr. C. B. van Niel,[7] of the Hopkins Marine Station, has examined several of these cultures and has confirmed their sterility.

So far it has not been possible to obtain in these sterile cultures a rate of growth equal to the highest rates obtainable in pure-mixed cultures of *Paramecium* and single strains of bacteria. The best fission rate obtained in these cultures to date is approximately 0.5 divisions per day. Fission rates of 1.0–2.0 per day have been reported for pure-mixed cultures. Heated yeast juice will not support the growth of *Paramecium*. Some factor or factors necessary for their growth is apparently destroyed by heat. This is in line with other observations which have been made on *Paramecium* and other ciliates. Most of the normally holozoic forms that have been studied will not grow when furnished with heat-killed organisms or with the ordinary heat-treated culture media as their only source of food.

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THE SIGNIFICANCE OF FIBRINOLYSIS IN THE MECHANISM OF COAGULATION OF BLOOD[1]

WHEN recalcified dog's plasma is shaken briefly with chloroform and allowed to stand 24 hours, and the chloroform thereafter removed, the serum so obtained shows marked fibrinolytic properties. The properties of this so-called chloroform serum will be reported elsewhere.[2]

The precipitate of globulin obtained from this chloroform serum by isoelectric precipitation at pH 6 is soluble in isotonic saline solution. This solution of globulin possesses marked fibrinolytic properties.

The addition of small amounts to a solution of fibrinogen produces no clot but complete lysis of the fibrinogen. In the presence of prothrombin, however, a clot forms which may undergo fibrinolysis. The addition of the globulin solution to oxalated plasma results in coagulation sometimes followed by fibrinolysis. The addition of the globulin solution to prothrombin results in the formation of thrombin in the absence of calcium, thromboplastin or formed blood elements. In its action on blood plasma and fibrinogen the globulin solution resembles the action of trypsin as reported by Eagle and Harris.[3]

The active globulin solution may also be prepared by dialysis of chloroform serum against running water. In this preparation the active fibrinolytic substance is associated with the euglobulin precipitate. The solution in isotonic saline of this precipitate behaves as does the isotonic saline solution of the acid precipitated globulin.

It is to be noted that the methods of precipitation and dialysis are similar to those used in the preparation of "globulin substance" by Patek and Taylor.[4]

HENRY J. TAGNON[5]

[7] We wish to express our appreciation to Dr. C. B. van Niel for first suggesting yeast juice as a possible medium, and for making sterility tests of our cultures.

[1] From the New York Hospital and the Department of Medicine, Cornell University Medical College, New York, N. Y.

[2] Henry J. Tagnon, *Jour. of Lab. Clin. Med.*, in press.

[3] H. Eagle and T. N. Harris, *Jour. Gen. Phys.*, 20: 543, 1937.

[4] A. J. Patek, Jr., and F. H. L. Taylor, *Jour. Clin. Invest.*, 16: 113, 1937.

[5] Graduate fellow of the Belgian American Educational Foundation.

BOOKS RECEIVED

Advances in Enzymology. F. F. NORD and C. H. WERKMAN, editors. Volume II. 23 illustrations. Pp. viii + 374. Interscience. $5.50.

HARTKEMEIER, HARRY PELLE. *Principles of Punch-Card Machine Operation.* Illustrated. Pp. xiv + 260. Crowell. $3.25.

HOU, TE-PANG. *Manufacture of Soda.* American Chemical Society Monograph Series, number 65. Second edition. 149 illustrations. Pp. xviii + 590. Reinhold. $9.50.

LAURIE, ALEX and VICTOR E. RIES. *Floriculture.* Illustrated. Pp. vii + 496. McGraw-Hill. $4.00.

MUELLER-DEHAM, ALBERT and S. MILTON RABISON. *Internal Medicine in Old Age.* Pp. ix + 396. Williams and Wilkins. $5.50.

Science and World Order. The British Association for the Advancement of Science, report. Pp. 120.

SEEMAN, ALBERT L. *Physical Geography.* Pp. xxii + 439. Prentice-Hall. $3.50.

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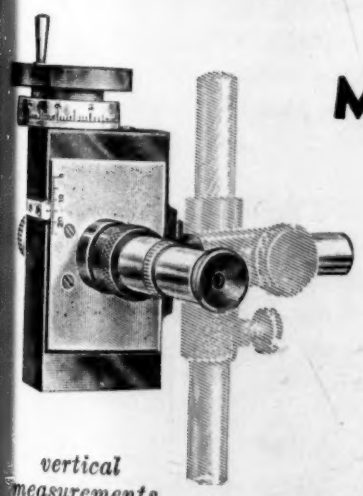
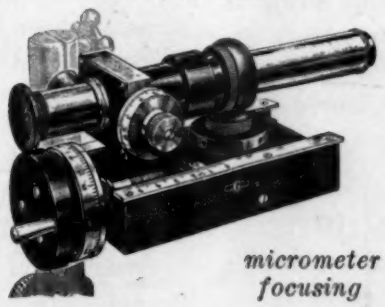


vertical measurements

depth measurements



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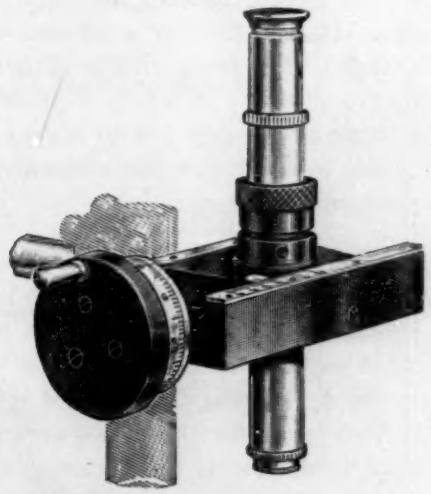
horizontal measurements



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SCIENCE NEWS

Science Service, Washington, D. C.

THE GRAVITATIONAL CONSTANT

COMPLETION of a new measurement of the power of matter to attract other matter, known as the constant of gravitation, has been announced by Dr. Paul R. Heyl, physicist of the National Bureau of Standards.

The new figures for the constant (multiplied by 100,000,000) are 6.673 plus or minus 0.003, as compared with the generally accepted value of 6.670 plus or minus 0.005, which was also obtained by Dr. Heyl at the Bureau in 1930. The very small difference between the two values bespeaks the high accuracy of both measurements. That the new value is more accurate than the old is evidenced by the "probable error," 0.003 of the new value, as compared with 0.005 for the old.

This increase in accuracy, Dr. Heyl stated, was due to two improvements made in the apparatus, which otherwise was the same as that used in 1930. Many improvements were suggested and some were tried but only two adopted, Dr. Heyl said, and he believes that the limit of accuracy has about been reached and that any substantial further improvement will require that a radically different method be found.

The constant of gravitation may be defined as the force with which two particles of matter, each having a mass of one gram, attract each other when one centimeter apart. (A gram is the 28th part of an ounce and a centimeter is about 0.4 of an inch.)

Since, in the words of Newton, "Every particle of matter in the universe attracts every other particle . . . ," any two objects on the earth, of whatever material, should attract each other. They do, and this attraction is precisely what is used in determining the gravitational constant. But the force is so exceedingly small, as compared with that of the enormously greater earth which is evidenced as weight, that only an extremely sensitive instrument can detect or measure it.

This instrument has nearly always been a refined form of the torsion balance invented by Cavendish 150 years ago. It is a kind of pendulum whose time of swing is changed when the positions of two massive weights near-by are altered. It is very impressive to observe that when a bottle of mercury (which is very heavy) is removed from a near-by shelf and put somewhere else, the swing of the pendulum is altered.

THE FLUORESCENCE OF DIAMONDS

WHY some genuine diamonds fluoresce or glow a brilliant blue, others yellow and most of them not at all, when exposed to ultraviolet (or "black") light, was revealed by burning the precious stones in an electric arc.

This is the first time that so drastic a method has been used to determine the cause of fluorescence in diamonds which milder methods had failed to disclose. The light from the burning diamond was analyzed by a powerful spectrograph, an instrument which sorts out the light of the burning diamond according to its various wave lengths, and tells what elements are present in the stone as impurities.

These impurities were found to be the cause of the various types of fluorescence. The blue-glowing diamond was found to contain chromium and titanium as the principal impurities, the yellow-glowing gem contained aluminum, and the non-fluorescing stones were almost pure carbon.

The investigators were James M. Orr, spectroscopist, and Jack De Ment, chemist, both of Portland, Ore., who report full details of the investigation in the current issue of *The Mineralogist*.

LIGNITE A SOURCE OF HYDROGEN

HYDROGEN, used in welding torches, ammonia manufacture and a thousand other industrial applications, can be manufactured cheaply and abundantly from a natural resource possessed in great masses by this country, but at present very little used—lignite. A new process for obtaining hydrogen from this light-weight, coal-like substance has been recognized with a U. S. patent (no. 2,276,343), issued to Professor Lloyd H. Reyerson and Donald C. Gernes, of the University of Minnesota. Rights have been assigned to the incorporated regents of the university.

When steam is passed over any carbonaceous substance that has been heated to incandescence, it is cracked into hydrogen and oxygen. The oxygen combines with some of the carbon to form carbon monoxide. One of the methods of manufacturing cooking gas is to blow steam through heated coal or coke. The resulting mixture of carbon monoxide and hydrogen has high fuel value, but the high percentage of monoxide is undesirable when the objective is the production of commercial hydrogen.

Professor Reyerson and Mr. Gernes have discovered that an analogous process carried out with lignite can be performed at much lower temperatures than are necessary with coal or coke, and that the resulting gas contains far less of the troublesome carbon monoxide. It is therefore easier and cheaper to remove the monoxide. This is the key to their patent.

There are immense beds of lignite in the Northwest, some of those in North Dakota being 30 feet or more in thickness. At present, lignite is little used, except locally for domestic fuel. The Reyerson-Gernes process may tap this resource for the benefit of American hydrogen-using industries.—FRANK THONE.

STEEL, OIL AND LABOR

STEEL, oil and labor, the chief sinews of our war production, are saved by using recording or ticket-printing meters to measure oil as it flows through pipes, instead of pouring it into tanks. This was pointed out by L. R. Van Arsdale, of the Pittsburgh Equitable Meter Company, in an address to the American Society of Mechanical Engineers.

In the Army and Navy, trucks and warship tenders are equipped with these meters. They have been used for several years in some of the new oil fields, also in trunk pipelines and delivery trucks. Nevertheless, their use is somewhat in its infancy.

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An oil refinery gathers up its crude through a vast system of pipelines coming from many fields. The contribution of each field must be measured. The oil in these pipes is under constant pressure, so that by measuring it by meters in the pipe, the oil is never exposed to atmospheric pressure as it is when poured into tanks. This prevents loss of valuable gasoline vapors, particularly important in the manufacture of 100-octane gasoline for aviators. It saves also a vast amount of steel in tanks and in pipes and pumps to serve them.

Leaks are quickly located by use of meters which record the pressure and the rate of flow on a chart. A drop in pressure means either a leak in the pipe ahead or trouble with the pumps behind. These meters distinguish between the two causes, thus avoiding sending out a crew of men to "walk the line" and another to investigate the pumps and saving many man-hours and long delays. The meters are more accurate than the older methods and the ticket-printing feature saves time and mistakes in keeping records and accounts. Further savings are effected by pumping natural gas back into the oil sands. The increased pressure thus obtained raises the oil in the wells and holds back the infiltration of water, which usually spells the end of an oil well. This gas is otherwise wasted by burning in flares.

COTTON PICKING MACHINES

COTTON must meet the harvester half way, if successful machine harvesting of this number one textile crop is ever to replace the present back-bending, neck-blistering, finger-wearying method of hand picking, was stated by H. P. Smith and D. T. Killough, of Texas A. and M. College, at the Houston meeting of the American Society of Mechanical Engineers.

Machines for harvesting cotton fall into two main classes—pickers and strippers. Pickers undertake to pull the lint out of the boll, duplicating the hand job by either mechanical or pneumatic means. Strippers tear boll and all from the plant, and try to extract the lint as cleanly as possible afterwards.

Both types of machines run into difficulties, because of the innate perverseness of the cotton plant itself. Wheat, corn and other crops now harvested by machinery are relatively simple jobs: they ripen all at the same time, they bear their fruit at or near the same level, they don't hang on too tightly. Cotton ripens unevenly at all levels on plants of varying height, with wide differences in "pluckability" of the lint.

Engineers, being mechanical-minded, have a tendency to build cotton-harvesting machines that really ought to do the job, and then are bewildered and annoyed when the cotton plant crosses them up. The answer, in the opinion of Messrs. Smith and Killough, lies partly in patiently trying to make the machine better adapted to its difficult crop, partly in trying to breed cotton varieties that will be less difficult for the machine to handle. Some success has been achieved in the latter direction, they indicated, but a great deal still remains to be accomplished before the perfect "machine" cotton can be proclaimed as ready for the fields.

MALNUTRITION

DESPITE record crops and meat and fish production, large but unknown number of Americans are always hu gry. This is the implication of a study of malnutriti in this country by Drs. Norman Jolliffe, James McLester and H. C. Sherman, of the Food and Nutriti Board of the National Research Council. The study reported in the *Journal* of the American Medical Asso ciation.

After consideration of various surveys, records fro hospitals, schools, population groups and mortality figur the three physicians conclude: "... dietary inadequ cies and malnutrition of varying degrees are of freque occurrence in the United States ... and the nutritiona status of an appreciable part of the population can b distinctly improved. If optimal nutrition is sought, n mere adequacy, then wide-spread improvement is po sible."

From records of the Bureau of Home Economics, D partment of Agriculture, of more than 2,000 families o wage earners, clerical workers and non-relief, non-sha cropper farm families from all sections of the country, was learned that 43.6 per cent. of these families failed t receive a "fair" diet, and 76.2 per cent. did not get "good" diet. Diets were generally better on the far than in the city.

Evidence of poor eating habits from mortality statistic (1933–38) was less clear, although pellagra, beriber scurvy and rickets took their toll. Of these, pellag caused by far the most deaths, the number in 1938 bei 3,205 as compared to 244 for rickets, the next most fr quent cause of death. However, poor nutrition is oft a non-recorded cause of death, and the authors wond how much malnutrition is concealed in the 370,600 deat recorded in 1938 under the heading "diseases of the ci culatory system," or in the 75,431 deaths entered und its sub-classification, "diseases of the heart, unspecified, etc.

Likewise uncertain is evidence of malnutrition bas on hospital records. While the amount of actually diag nosed malnutrition was low, again the authors belie much was unobserved. They point out that the degr of malnutrition varies between "slight," a conditio which even a physician may miss, and conditions so ser ous that death results.

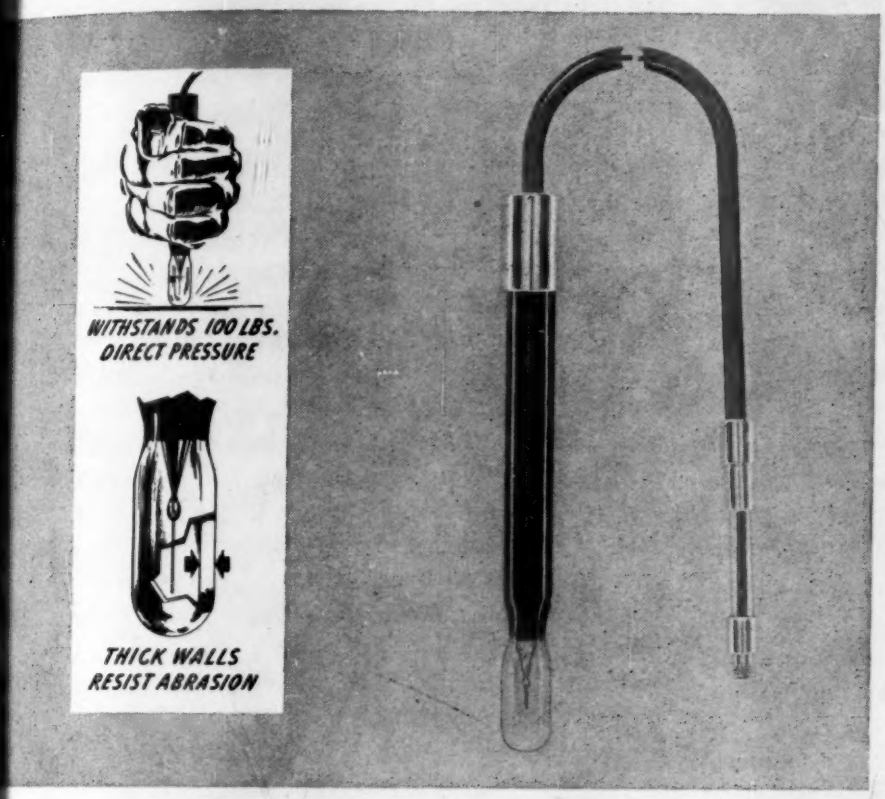
A slight degree of malnutrition, known as "hidde hunger," is probably very prevalent among American and the authors believe the rate is sufficiently high "t occasion genuine concern."

GLAND CONTROL

NEW discoveries in the field of gland control of th body's functions were described in a lecture at Louisian State University by Professor Herbert M. Evans, of th University of California. The lecture was given unde the auspices of the Society of the Sigma Xi, the nationa honor society for the promotion of scientific researc Professor Evans will lecture at a number of other un versities in this country during the coming two months.

BECKMAN pH NEWS

FROM THE WORLD'S LARGEST MANUFACTURER OF GLASS ELECTRODE pH EQUIPMENT



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The immersion end of this electrode, in place of the usual bulb, has a blunt pH-sensitive section approximately 12 mm in diameter. This section, made of special electrode glass, has a thick wall that is extremely rugged and will withstand severe operating stresses that would break ordinary glass electrodes. For example, the tip of this electrode can be pushed into the ground or against hard surfaces with a direct force of *more than one hundred pounds* without damage!

The electrode is completely sealed and internally shielded, with a shielded lead permanently attached for plugging directly into the instrument. It can be used with any standard Beckman Calomel Electrode and is available in two models—one for the Beckman Industrial pH Meter, the other for the Beckman Laboratory Meter. When ordering, please advise for which instrument electrode is desired.

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The particular subject which claimed his attention was the anterior lobe of the pituitary gland and its secretions. The pituitary is a small body located within the skull, just under the brain. Its influences, however, reach throughout the body, and are so numerous and so important that the pituitary is sometimes called the "master gland."

One pituitary substance which the speaker discussed is a secretion that controls body growth. It is suspected that this so-called growth hormone may in reality be two hormones. Animals deprived of growth hormone invariably make less efficient use of food in body building than do those receiving normal amounts of the substance.

Another pituitary hormone is active in promoting the production of milk, cooperating in this function with other hormones produced elsewhere in the body, especially in the female sex glands. "It may turn out," Professor Evans said, "to be a new and valuable drug in preventing the rare disorder known as habitual abortion shown by otherwise healthy women."

A third hormone produced by this same small gland, and quite recently discovered, plays an important part in the activities of the pancreas, which in turn control the efficiency of food utilization when normal, and result in diabetes when deficient.

ITEMS

FROM Finland comes news of a mysterious celestial object traveling rapidly northward in the same part of the sky that was traversed by Whipple's comet. If the new object turns out to be a comet, it will be the second one this year. The discovery was made on March 12 by Y. Vaeisaelae, director of the Observatory of Turku, Finland. The Harvard College Observatory, a clearing house for astronomical information, received the news and transmitted it to American observatories. None of these has as yet confirmed the discovery and the Harvard astronomers have been unable to find the object on their patrol plates.

AUTOMATIC recordings of electrical conditions in the upper atmosphere have made it possible to predict with accuracy the best frequency (or wavelength) to use in short-wave radio communication between given points, for a given season of the year and a given time of day. This announcement was made by Dr. T. R. Gilliland at a meeting of the Washington Academy of Sciences. The automatic multi-frequency recorder is a development of the technique used by Dr. Gregory Breit and Dr. M. A. Tuve in the United States and Professor E. V. Appleton in England about sixteen years ago to investigate the ionosphere or electrically conducting layers of the upper atmosphere. Their method was to send up short pulses of high-frequency waves of different wavelengths and measure the echo time or time for the waves to go up and back. These layers change greatly from day to night and from summer to winter and according to the number of sunspots on the sun, and greatly affect short-wave communication. Automatic recordings have now been made in several parts of the world for almost one complete sunspot cycle of eleven years. It is these recordings that now make it possible to specify the best wavelength to use under any particular circumstances.

SULFAGUANIDINE, one of the more recently develop drugs of the sulfa group, has been found effective Dr. J. R. Beach, of the University of California Col of Agriculture, in the treatment of cecal coccidiosis, of the most troublesome of poultry diseases. He is n engaged in experiments to determine the possible va of the drug in other related poultry maladies. As y the treatment is on an experimental basis, for sulf guanidine has not been released for general use and still quite expensive. Its cost may be brought down, ho ever, if a large-scale use can be found.

EXPERIMENTS in planting cork oak, from which cork stripped, are planned by the Department of Agricultu if the Forest Service can get acorns from the Medit ranean. Normally this country imports about $10,000,0 worth of cork every year from Spain, Portugal and Nor Africa. Parts of the Southwest—southern Californ Arizona, New Mexico and Texas—have a similar climat and cork should do well here. From a few cork oa planted in California more than seventy years ago, gro first-yield cork has been gathered under supervision of t Agricultural Extension Service of the University of Ca fornia. Several native trees already produce a kind cork suitable for several types of products, such as ho insulation and packing material. These include Sout western fir, which produces a soft pure cork, and the m common Douglas fir, with its corky outer bark. White also offers some possibilities.

A CARGO of gold worth some $8,000,000 has been rec ered from the strong room of the ship Niagara, sunk June, 1940, by enemy mines 27 miles off the New Zeala Coast, according to the Australian News and Informati Bureau. The gold was recovered in recent operati which located the ship under 438 feet of water. T salvage is believed to be the deepest ever undertaken a was accomplished by a Melbourne company in cooperati with the Australian Navy and the New Zealand Gover ment. Members of the salvage crew recovered 150 mi which had been laid around the wreck area by the enem

MARKED relief from the familiar condition, "ringi in the ears," was obtained in a series of cases treat with the synthetic chemical, Prostigmin, Captain A. Judge, Medical Reserve, U. S. Army, reports in the c rent issue of the *Military Surgeon*, the official publicati of the Association of Military Surgeons of the U. S. Ca tain Judge also treated cases of deafness, but obtained on a few improvements. He notes, however, that in view the scarcity of drugs which relieve deafness to any exte the use of Prostigmin should not be abandoned. Ca of the "ringing" or other noises in the ear is not alwa known. Sometimes it is a plug of wax. An overdose quinine will do it. Sharp explosions such as gunfire a bombs will sometimes cause it. Neither is the action Prostigmin clear, and there is much controversy over i value in relieving "ear noises." He, however, treat fourteen cases of ringing-in-the-ears with Prostigmin a gave complete relief to five, marked improvement to fo and some benefit to three. Two patients were in no w helped.